RESPOSTAS DOS EXERCÍCIOS E TESTES

1 CONJUNTOS NUMÉRICOS

EXERCÍCIOS

1. $A \cap B = \{x \in \mathbb{N} \mid 1 \leq x < 7\}$ e $A \cup B = \{x \in \mathbb{N} \mid x < 8\}$

2. $C \cap D = \{x \in \mathbb{N} \mid 1 \leq x \leq 9\}$ e
   $C \cup D = \{x \in \mathbb{Z} \mid -2 \leq x \leq 10\}$

3. a) -2 b) 14 c) 11 d) 3

4. a, c, d

5. a) $0{,}6$ b) $1{,}\overline{3}$ c) $0{,}14$ d) $0{,}2\overline{3}$ e) $1{,}875$ f) $2{,}72$

6. a) $\frac{5}{9}$ b) $\frac{8}{3}$ c) $\frac{20}{11}$ d) $\frac{65}{9}$ e) $\frac{437}{330}$ f) $\frac{5\,637}{1\,100}$

7. 11

8. $8{,}3\overline{5}$

9. $\frac{12}{23}$

10. $\frac{19}{20} < 1 < 1{,}\overline{2} < \sqrt{2} < \sqrt{3} < \sqrt{5}$

11. $\frac{\sqrt{5}}{2} > \frac{21}{20} > 1 > 0{,}\overline{8} > \frac{\sqrt{2}}{2} > \frac{\sqrt{3}}{3}$

12. a) $\frac{4}{11}$ b) $\frac{1}{\sqrt{2}}$ c) $\frac{\sqrt{3}}{2}$ d) $\frac{3\sqrt{5}}{2}$

13. a) F b) F c) V d) F

14. a) 9
    b) $\frac{125}{44}$ ou $2{,}84\overline{09}$
    c) $\frac{38}{9}$ ou $4{,}\overline{2}$
    d) $-\frac{133}{45}$ ou $-2{,}9\overline{5}$

15. $A = \sqrt{2}$, $B = 3\sqrt{2}$ e $A \cdot B = 6$

16. $\frac{90}{49}; -\frac{9}{11}$

17. a) 1
    b) $\frac{3}{2}$
    c) 0 $\frac{9}{2}$
    d) -1 3
    e) 0 4
    f) -2 2

18. a) $A = \{x \in \mathbb{R} \mid -3 \leq x \leq 4\}$
    b) $B = \left\{x \in \mathbb{R} \mid x < -1 \text{ ou } x > \frac{7}{2}\right\}$
    c) $C = \{x \in \mathbb{R} \mid -2 < x \leq 0 \text{ ou } 2 \leq x < 3\}$

19. a) $A = \{x \in \mathbb{R} \mid -2 < x \leq 5\}$
    b) $B = \{x \in \mathbb{R} \mid x < 1\}$
    c) $C = \left\{x \in \mathbb{R} \mid x \geq -\frac{1}{2}\right\}$

20. $A \cup B = [-1, 4]$ e $A \cap B = [0, 3]$

21. $C \cup D = [0, 3[$ e $C \cap D = \left]\frac{1}{2}, \frac{5}{2}\right]$
    $G \cup H = \mathbb{R}$ e $G \cap H =]-1, 5]$

22. $I \cap J \cap K = \left[-\frac{1}{3}, \frac{3}{2}\right[$

TESTES DE VESTIBULARES

1. e
2. c
3. b
4. b
5. c
6. d
7. a
8. e
9. c
10. c
11. c
12. a
13. c
14. a
15. c
16. a
17. e
18. e

2 FUNÇÕES

EXERCÍCIOS

1. a) R$ 63,00 b) 25 quilos c) $p = 14 \cdot n$

2.

Nº de litros	0,5	2	3	10	20	40
Distância (km)	6	24	36	120	240	480

3. a) 22 b) $y = 50 + 22x$

4. a)

Nº de pedreiros	1	4	6	8	12
Nº de dias	24	6	4	3	2

b) $d = \frac{24}{n}$

5. a)

15 min	200 km
0,5 hora	400 km
2 horas	1 600 km
5 horas	4 000 km

b) 6,5 horas c) $d = 800 \cdot t$

6. a)

Nº de horas	1	2	3	4	5	6
Nº de células	2	4	8	16	32	64

b) 10 horas c) $n = 2^t$

7. a) sim b) sim c) não d) não

8. a) sim b) sim c) não d) sim

9. a) $y = \frac{x}{2}$ b) $y = x + 1$ c) $y = x$

10. a) 6 b) 8 c) 4 d) $\frac{17}{4}$ e) $10 - \sqrt{2}$

11. a) $f(0) = 6$; $f(-2) = 4$ e $f(1) = 4$ b) 4 ou -5

12. a) -3 b) 3 c) 5 d) Não existe. e) -15

13. a) 6 b) Não existe. c) 2 d) Não existe. e) 12

14. a) 4 b) 6 c) $-\frac{5}{2}$

15. a) $\frac{16}{7}$ b) 1 ou $-\frac{4}{3}$ c) $-\frac{43}{2}$

16. a) 22 °C b) 31 °C

17. a) V
b) F; 110 min × 90 min.
c) V; aumenta em 6 min.

18. a) -3 b) -9 c) -33

19. a) 3 b) $f(9) = 7$; $f(81) = 67$

20. a) -900 b) R$ 200,00

21. 36

22. a) $a = 4$; $b = 1$; $c = -1$ b) 4

23. a) 164 cm = 1,64 m
b) Paulo: 56 kg; Paula: 54 kg

24. a) D = A; CD = B e $Im = \{1, 2, 5\}$
b) D = A; CD = B e $Im = \{-3, -1, 1, 3\}$
c) D = A; CD = B e Im = B
d) D = A; CD = B e $Im = \mathbb{R}$

25. a) $\mathbb{R}$ b) $\mathbb{R}$ c) $\mathbb{R}^*$ d) $\mathbb{R} - \{1\}$ e) $\mathbb{R} - \{0, 2\}$

26. a) $D = \{x \in \mathbb{R} \mid x \geq 5\}$
b) $\mathbb{R}$
c) $D = \{x \in \mathbb{R} \mid x > 3\}$
d) $D = \{x \in \mathbb{R} \mid x \geq -1 \text{ e } x \neq 0\}$
e) $D = \{x \in \mathbb{R} \mid x > 0\}$

27. a) $D = \{x \in \mathbb{R} \mid x \geq 0\}$
b) $D = \left\{x \in \mathbb{R} \mid x \geq \frac{1}{2}\right\}$
c) $D = \left\{x \in \mathbb{R} \mid 1 \leq x \leq \frac{5}{3}\right\}$

28. a) $\mathbb{R} - \left\{0, \frac{3}{4}\right\}$ b) $\mathbb{R} - \{0, -2, 2\}$ c) $\mathbb{R}$

29. a) V b) V c) V d) V

30. a) F; as vendas caíram em 2002 em relação a 2001 e em 1998 em relação a 1997.
b) F; é de 18,3% aproximadamente.
c) F; a seqüência é (2,4; 6,1; 4,9; 4,8; 11).
d) V; é 5,84 milhões.

31. a) V b) V c) F d) V e) V

32. a) V b) F c) V d) V e) F

33. a) 1970 a 1980: 10; 1985 a 1988: 33; 1990 a 1992: 37
b) 1979 a 1983; 1989 a 1991; 1994 a 1995; 2001 a 2003
c) 2002, 2003 e 2005
d) 1978 e 1979
e) 31,5 e 9,2

34. a) 14 800 b) 2 880

35.

y, I, B, M, L, A, H, G, E, x, D, F, N, C, J

36. A(4, 2); B(−4, 6); C(−5, −3); D(4, −5); E(0, 4); F(−3, 0); G(0, −6); H(5, 0); I(0, 0)

37. a) $x = 2$; $y = -5$ c) $x = 4$; $y = -1$
b) $x = 1$; $y = 4$

38. a) $m = -2$ d) $m > 0$
b) $m = 4$ ou $m = -4$ e) Não existe *m*.
c) $m < 0$ f) $m > 0$

39. $m = 5$

40. a)

c)

b)

d)

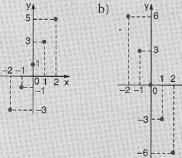
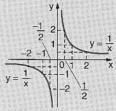
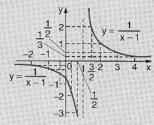
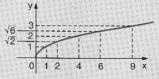
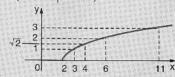
41. a) b) c)

42. c) Qualquer $x < 0$ está associado a dois valores de *y*.
d) $x = -3$ tem duas imagens: 1 e −1.
e) Quando $x \in]-1, 1[$, não há imagem correspondente.
g) $x = 1$ está associado a infinitos valores de *y*.

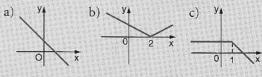
43. a) 3 c) −4 e) 6 g) 2
b) 2 d) −4 f) 1 h) infinitos

44. a) $V = 10\,000 - 100t$
b) 100
c)

45. a)

b)

46. a) $D = \mathbb{R}^*$

b) $D = \mathbb{R} - \{1\}$

47. a) $D = \{x \in \mathbb{R} \mid x \geq 0\}$

b) $D = \{x \in \mathbb{R} \mid x \geq 2\}$

48. a) *f* é crescente se $x > 0$.
f é decrescente se $x < 0$.
b) *f* é crescente se $x > -3$.
f é decrescente se $x < -3$.
c) *f* é constante se $x < 2$.
f é crescente se $x > 2$.
d) *f* é crescente se $-2 < x < 4$.
f é decrescente se $x < -2$ ou $x > 4$.

49. a) $x > -3 \Leftrightarrow y > 0$
$x < -3 \Leftrightarrow y < 0$
raiz: −3
b) $x < 0$ ou $x > 2 \Leftrightarrow y > 0$
$0 < x < 2 \Leftrightarrow y < 0$
raízes: 0 e 2
c) $x < -1$ ou $x > 1 \Leftrightarrow y > 0$
$-1 < x < 1 \Leftrightarrow y < 0$
raízes: −1 e 1
d) $x < -3$ ou $0 < x < 4 \Rightarrow y < 0$
$-3 < x < 0$ ou $x > 0 \Rightarrow y > 0$
raízes: −3, 0 e 4

50. Respostas possíveis:

51. a) 2:00 e 8:00 c) $0 \leq t < 2$ ou $8 < t \leq 24$
b) [−5, 13]

52. a) freqüência = 2 000 Hz
nível de audição = 50 dB
b) de 2 000 Hz a 8 000 Hz

53. a) P b) I c) O d) I e) P

TESTES DE VESTIBULARES

1. b	6. a	11. d	16. c
2. a	7. a	12. e	17. e
3. d	8. a	13. e	18. c
4. b	9. c	14. d	19. c
5. c	10. a	15. e	20. a

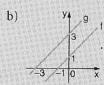
3 FUNÇÃO AFIM

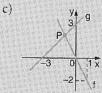
EXERCÍCIOS

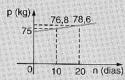
1. a) c) b) d)

2. a) c) b) d)

3. a) P(−1, 5)

b)

As retas são paralelas; não há ponto de interseção.

c)

P(−1, 2)

4. a) 76,3 kg, aproximadamente
b) $p = 75 + 0{,}18n$

c) Sim; após um mês ele terá 80,4 kg.

5. a) $y = -3x + 2$ c) $y = 4x$
b) $y = \frac{1}{2}x + 4$ d) $y = 2$

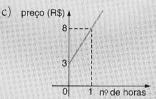
6. a) $y = 0{,}05x + 300$ c) não
b) 300 reais

7. a) 1 440 b) 400 c) 1 430

8. $v = -900t + 10\,000$

9. R$ 6 000,00

10. a) I → $y = 100 - 2{,}5x$
II → $y = 80 - \frac{5x}{3}$
b) 24º dia

11. a) 3
b) R$ 15,50
c)

12. Não; na opção III ele pagaria R$ 54,00 e alugaria a mesma quantidade (18) de DVDs.

13. a) 1 b) 2 c) 3,5

14. a) 15 anos
b) US$ 1 400
c)

15. a) $a = -2; b = 5$ d) $a = 1; b = 3$
b) $a = 3; b = -1$ e) $a = 1; b = -1$
c) $a = 4; b = 0$

16. a) 20 horas b) $v = 1\,300t$

17. a) $S = \left\{\frac{3}{10}\right\}$ d) $S = \varnothing$
b) $S = \{6\}$ e) $S = \{-1\}$
c) $S = \{1\}$ f) $S = \left\{\frac{15}{11}\right\}$

18. 25

19. *A* recebe R$ 75,00, *B* recebe R$ 30,00 e *C* recebe R$ 15,00.

20. a) André: 20 anos; Carlos: 24 anos b) 28

21. 56 anos

22. a) $\frac{1}{3}$ c) $-\frac{5}{3}$ e) $\frac{5}{6}$

b) $\frac{1}{2}$ d) 0

23. $-\frac{15}{2}$

24. 1 U.A.

25. crescentes: *a*, *d*, *e*
decrescentes: *b*, *c*

26. a) $m > 0$ b) $m < -3$ c) $m < 2$

27. a) $x > -1 \to y > 0$
$x < -1 \to y < 0$
b) $x > 2 \to y < 0$
$x < 2 \to y > 0$

28. a) $\begin{cases} x > -\frac{1}{4} \to y > 0 \\ x < -\frac{1}{4} \to y < 0 \end{cases}$

b) $\begin{cases} x < \frac{1}{3} \to y > 0 \\ x > \frac{1}{3} \to y < 0 \end{cases}$

c) $\begin{cases} x < 0 \to y > 0 \\ x > 0 \to y < 0 \end{cases}$

d) $\begin{cases} x > 3 \to y > 0 \\ x < 3 \to y < 0 \end{cases}$

e) $\begin{cases} x > 0 \to y > 0 \\ x < 0 \to y < 0 \end{cases}$

29. $\begin{cases} x > -3 \to y > 0 \\ x < -3 \to y < 0 \end{cases}$

30. a) $\{x \in \mathbb{R} \mid x \leq 4\}$
b) $\{x \in \mathbb{R} \mid x \leq -1\}$
c) $\{x \in \mathbb{R} \mid x > 1\}$
d) $\left\{x \in \mathbb{R} \mid x > \frac{6}{5}\right\}$
e) $\{x \in \mathbb{R} \mid x \geq -8\}$
f) $S = \varnothing$
g) $\left\{x \in \mathbb{R} \mid x \leq \frac{14}{3}\right\}$

31. 1, 2 e 3

32. a) v(n) = 190 + 28n b) 12 meses

33. a) *B*; *A* b) 16 km

34. a) *B*; R$ 1,00 b) 200 minutos

35. a) plano *A*: R$ 57,50; plano *B*: R$ 40,00
b) 68 minutos

36. a) *A*: R$ 600,00
B: R$ 420,00
b) 28 000 km

37. a) $\left\{x \in \mathbb{R} \mid -\frac{1}{2} \leq x \leq 2\right\}$
b) $\{x \in \mathbb{R} \mid 4 < x < 6\}$
c) $\{x \in \mathbb{R} \mid -4 < x < 1\}$
d) $\left\{x \in \mathbb{R} \mid 2 \leq x \leq \frac{5}{2}\right\}$
e) $\{x \in \mathbb{R} \mid -2 \leq x < 3\}$

38. a) $\{x \in \mathbb{R} \mid x \geq 1\}$
b) $S = \varnothing$
c) $\left\{x \in \mathbb{R} \mid -\frac{5}{3} < x \leq \frac{4}{3}\right\}$

39. a) *B*; *B* b) 84 km

40. a) $\{x \in \mathbb{R} \mid x \leq 1 \text{ ou } x \geq 2\}$
b) $\left\{x \in \mathbb{R} \mid \frac{1}{2} < x < 2\right\}$
c) $\left\{x \in \mathbb{R} \mid x \leq -\frac{2}{5} \text{ ou } x \geq 1\right\}$
d) $\left\{x \in \mathbb{R} \mid x \leq -\frac{3}{5} \text{ ou } -\frac{1}{4} \leq x \leq \frac{3}{2}\right\}$
e) $\left\{x \in \mathbb{R} \mid x \leq 0 \text{ ou } \frac{1}{2} \leq x \leq 3\right\}$

41. 2

42. $D = \left\{x \in \mathbb{R} \mid \frac{1}{2} \leq x \leq 2\right\}$

43. a) $S = \{2\}$ b) $S = \mathbb{R} - \{3\}$ c) $S = \varnothing$

44. a) $\left\{x \in \mathbb{R} \mid -1 \leq x < \frac{1}{2}\right\}$
b) $\left\{x \in \mathbb{R} \mid x < \frac{3}{4} \text{ ou } x > \frac{3}{2}\right\}$
c) $\{x \in \mathbb{R} \mid 0 \leq x < 3\}$

45. a) $\{x \in \mathbb{R} \mid x < -1 \text{ ou } 2 < x \leq 3\}$
b) $\left\{x \in \mathbb{R} \mid x < -2 \text{ ou } -\frac{1}{3} < x < 0\right\}$
c) $\left\{x \in \mathbb{R} \mid -\frac{3}{4} \leq x \leq \frac{1}{2} \text{ ou } x > 4\right\}$

46. a) $\left\{x \in \mathbb{R} \mid \frac{1}{7} \leq x < \frac{1}{2}\right\}$
b) $\left\{x \in \mathbb{R} \mid x < -\frac{3}{2} \text{ ou } x > 2\right\}$
c) $\{x \in \mathbb{R} \mid x < 1\}$
d) $\{x \in \mathbb{R} \mid x < 0 \text{ ou } x \geq 2\}$

47. a) $\{x \in \mathbb{R} \mid -1 \leq x \leq 2\}$
b) $\{x \in \mathbb{R} \mid x < -1 \text{ ou } x \geq 2\}$

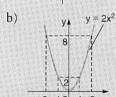
48. a) $D = \left\{x \in \mathbb{R} \mid x < -1 \text{ ou } x \geq \frac{3}{4}\right\}$
b) $D = \{x \in \mathbb{R} \mid 0 \leq x < 1 \text{ ou } x \geq 2\}$

TESTES DE VESTIBULARES

1. d
2. d
3. a
4. c
5. e
6. c
7. e
8. d
9. e
10. e
11. d
12. b
13. c
14. c
15. e
16. b
17. e
18. d
19. a) F b) V c) F d) F e) V
20. d
21. d
22. c

4 FUNÇÃO QUADRÁTICA

EXERCÍCIOS

1. a) C b) B c) B d) C e) C f) B

2. a)

c) $y = -x^2$

b)

d) $y = -2x^2$

3. a) $y = x^2 - 2x$

b) $y = -x^2 + 3x$

c) $y = -x^2 - 2x + 4$

4. a) $\frac{1}{2}$ e 1
b) 0 e 4
c) 5 e –3
d) $\frac{1}{3}$ e $-\frac{1}{3}$
e) 3
f) 0
g) Não existem.
h) $-\sqrt{2}$ e $\sqrt{2}$
i) –2 e 3

5. a) $S = \{-1, 2\}$
b) $S = \{-4, 2\}$
c) $S = \left\{\frac{3-\sqrt{5}}{2}, \frac{3+\sqrt{5}}{2}\right\}$
d) $S = \{-1, 1, 2\}$
e) $S = \{-5, 1\}$
f) $S = \left\{-\frac{2}{3}, 8\right\}$

6. a) $S = \{-2, -1, 1, 2\}$
b) $S = \{-\sqrt{5}, -\sqrt{3}, \sqrt{5}, \sqrt{3}\}$
c) $S = \{-3, 3\}$

7. a) 0; 1 b) 2

8. a) 3,5 e 9 b) abril

9. 15

10. $x = 0$ ou $x = 1$ ou $x = 100$

11. a) $3x^2 + 8x - 3$ b) 4

12. 12

13. $p = 1$

14. $\left\{m \in \mathbb{R} \mid m < \frac{4}{5}\right\}$

15. –1

16. a) $\begin{cases} m < 1 \rightarrow \text{2 raízes reais e distintas} \\ m = 1 \rightarrow \text{1 raiz real dupla} \\ m > 1 \rightarrow \text{nenhuma raiz real} \end{cases}$

b) $\begin{cases} m > -\frac{9}{8} \rightarrow \text{2 raízes reais e distintas} \\ m = -\frac{9}{8} \rightarrow \text{1 raiz real dupla} \\ m < -\frac{9}{8} \rightarrow \text{nenhuma raiz real} \end{cases}$

17. a) –2 e $\frac{2}{5}$
b) $m = -2 \rightarrow$ raiz dupla é 2
$m = \frac{2}{5} \rightarrow$ raiz dupla é $-\frac{8}{5}$

18. a) $S = \frac{1}{3}$ e $P = -\frac{5}{3}$
b) $S = 6$ e $P = 5$
c) $S = 0$ e $P = -\frac{7}{2}$
d) $S = 3$ e $P = -2$

19. a) $\frac{10}{3}$ b) $\frac{5}{3}$ c) 2 d) $\frac{70}{9}$

20. a) –8 e –3 b) 24

21. raízes: 11 e 14; p = 77

22. 3

23. a) 5 b) $\frac{1}{2}$

24. a) –4 b) 4

25. a) (3, –5); mínimo
b) $\left(-\frac{1}{4}, \frac{25}{8}\right)$; máximo
c) (0, –9); mínimo
d) (2, 0); mínimo
e) (0, 0); máximo

26. a) valor máximo = 450
b) valor mínimo = 4
c) valor máximo = –4
d) valor mínimo = 2

27. a) 18 horas b) 56 km

28. a) 35 m b) 3 s e 5 s c) 80 m d) 8 s

29. a) 1ª semana
b) sim; t = 2 (2ª semana)
c) 4ª e 5ª semanas

30. a) $k = \frac{33}{4}$ b) –4 °C

31. a) R$ –135,00; R$ 180,00
b) fevereiro e outubro
c) de junho em diante

32. a) 12 cm
b) $y = 32 - \frac{8x}{3}$
c) x = 6 cm e y = 16 cm; 50%

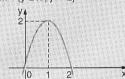
33. a) $f(t) = 2t - 4$ (para $0 \leqslant t \leqslant 2$). O golfinho saiu da água no instante 2 s.
b) O golfinho ficou fora da água 4 segundos; a altura máxima foi 3 metros.

34. a) 68 U.M. b) 5 e 5; 50 U.M.

35. a) Im = {y ∈ ℝ | y ≥ −1}

d) $Im = \left\{y \in \mathbb{R} \mid y \leq \frac{1}{4}\right\}$

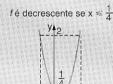
b) Im = {y ∈ ℝ | y ≤ 2}

e) Im = {y ∈ ℝ | y ≥ 4}

c) Im = {y ∈ ℝ | y ≥ 0}

36. a) *f* é crescente se x ≤ 0
f é decrescente se x ≥ 0

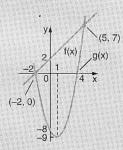
d) *f* é crescente se x ≤ −1
f é decrescente se x ≥ −1

b) *f* é crescente se $x \geq \frac{1}{4}$

f é decrescente se $x \leq \frac{1}{4}$

e) *f* é crescente se x ≤ 1
f é decrescente se x ≥ 1

c) *f* é crescente se x ≤ 1
f é decrescente se x ≥ 1

37. a) $y = -x^2 + 2x + 15$ c) $y = 4x^2 - 12x + 5$
b) $y = 2x^2 + 2x - 4$ d) $y = x^2 - 6x + 9$

38. Os pontos de interseção são (−2, 0) e (5, 7).

39. a) 80 m b) 800 m

40. m = −80 e n = 64 ou m = −20 e n = 4

41. a) $y = 100x + 42\,500$
b) $y = -x^2 + 1\,000x$
c) $y = -x^2 + 900x - 42\,500$
d) $50 < x < 850$

42. a) $a = -\frac{4}{3}; b = \frac{16}{3}; c = 3$ b) 8

43.

a) $\begin{cases} x < -3 \text{ ou } x > \frac{1}{3} \rightarrow y < 0 \\ -3 < x < \frac{1}{3} \rightarrow y > 0 \end{cases}$

b) $\begin{cases} x < -\frac{5}{4} \text{ ou } x > 1 \rightarrow y > 0 \\ -\frac{5}{4} < x < 1 \rightarrow y < 0 \end{cases}$

c) $\begin{cases} x \neq \frac{1}{3} \rightarrow y > 0 \\ \nexists\, x \in \mathbb{R} \mid y < 0 \end{cases}$

d) $\begin{cases} x < -\sqrt{2} \text{ ou } x > \sqrt{2} \rightarrow y < 0 \\ -\sqrt{2} < x < \sqrt{2} \rightarrow y > 0 \end{cases}$

e) $\begin{cases} x \neq 1 \rightarrow y < 0 \\ \nexists\, x \in \mathbb{R} \mid y > 0 \end{cases}$

f) $\forall x \in \mathbb{R}, y > 0$

44. a) $\begin{cases} x < 1 \text{ ou } x > 5 \rightarrow y < 0 \\ 1 < x < 5 \rightarrow y > 0 \end{cases}$

b) $\begin{cases} x \neq 0 \rightarrow y > 0 \\ \nexists\, x \in \mathbb{R} \mid y < 0 \end{cases}$

c) $\begin{cases} x \neq 2 \rightarrow y > 0 \\ \nexists\, x \in \mathbb{R} \mid y < 0 \end{cases}$

d) $\forall x \in \mathbb{R} \rightarrow y < 0$

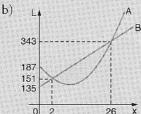
45. a) $\{x \in \mathbb{R} \mid -3 < x < 14\}$
b) $\left\{x \in \mathbb{R} \mid x < -2 \text{ ou } x > \frac{1}{3}\right\}$
c) $\{x \in \mathbb{R} \mid -1 < x < 5\}$
d) $S = \mathbb{R} - \left\{\frac{3}{2}\right\}$
e) $S = \mathbb{R}$
f) $S = \left\{\frac{4}{3}\right\}$

46. a) $S = \varnothing$
b) $\{x \in \mathbb{R} \mid 3 < x < 5\}$
c) $S = \varnothing$
d) $\{x \in \mathbb{R} \mid -7 < x < 5\}$
e) $\{x \in \mathbb{R} \mid x \leq -3 \text{ ou } x \geq -1\}$
f) $\left\{x \in \mathbb{R} \mid \frac{3 - \sqrt{13}}{2} < x < \frac{3 + \sqrt{13}}{2}\right\}$

47. a) $\{x \in \mathbb{R} \mid x \leqslant 0 \text{ ou } x \geqslant 3\}$
b) $\{x \in \mathbb{R} \mid -4 < x < 4\}$
c) $\left\{x \in \mathbb{R} \mid x \leqslant 0 \text{ ou } x \geqslant \frac{1}{3}\right\}$
d) $S = \mathbb{R}$
e) $\{x \in \mathbb{R} \mid -\sqrt{3} < x < \sqrt{3}\}$
f) $\left\{x \in \mathbb{R} \mid -\frac{1}{2} < x < 0\right\}$

48. $x > 15$

49. a) entre 3 e 25 unidades (incluindo tais extremos)
b)

50. a) $4 < p < 20$
b) $0 < p \leqslant 12$

51. a) $\{x \in \mathbb{R} \mid -3 \leqslant x \leqslant -2 \text{ ou } 2 \leqslant x \leqslant 3\}$
b) $\{x \in \mathbb{R} \mid -2 \leqslant x \leqslant 2\}$
c) $\{x \in \mathbb{R} \mid -3 \leqslant x < -\sqrt{3} \text{ ou } \sqrt{3} < x \leqslant 3\}$
d) $\{x \in \mathbb{R} \mid -3 \leqslant x < -2\}$

52. a) $\{x \in \mathbb{R} \mid -3 < x < -2\}$
b) $\{x \in \mathbb{R} \mid -2 < x < 1\}$
c) $\{-2, -1, 0, 1\}$

53. a) $\left\{x \in \mathbb{R} \mid x \leqslant -2 \text{ ou } 0 \leqslant x \leqslant \frac{3}{2} \text{ ou } x \geqslant 4\right\}$
b) $\{x \in \mathbb{R} \mid -3 < x < -1 \text{ ou } 1 < x < 2\}$
c) $\{x \in \mathbb{R} \mid x = -2 \text{ ou } x \geqslant 2\}$
d) $\{x \in \mathbb{R} \mid x > 2\}$

54. números inteiros negativos: 2
números inteiros positivos: infinitos

55. a) $\{x \in \mathbb{R} \mid -2 \leqslant x < 0 \text{ ou } 3 < x \leqslant 7\}$
b) $\left\{x \in \mathbb{R} \mid x < -1 \text{ ou } -\frac{1}{4} \leqslant x < \frac{1}{2} \text{ ou } x > 2\right\}$
c) $\{x \in \mathbb{R} \mid x < -2 \text{ ou } -1 \leqslant x \leqslant 0\}$
d) $\{x \in \mathbb{R} \mid x < 1 \text{ ou } 3 < x < 7 \text{ ou } x > 8\}$

56. a) $\{x \in \mathbb{R} \mid (x < 2, \text{ com } x \neq 2) \text{ ou } x > 3\}$
b) $\left\{x \in \mathbb{R} \mid x < -4 \text{ ou } 0 \leqslant x \leqslant \frac{1}{2} \text{ ou } 2 \leqslant x < 5\right\}$
c) $\{x \in \mathbb{R} \mid x \geqslant 2\}$
d) $\{x \in \mathbb{R} \mid -3 < x < -2 \text{ ou } -1 < x < 2 \text{ ou } x > 3\}$

57. a) $\{x \in \mathbb{R} \mid 0 \leqslant x \leqslant 2 \text{ ou } x = 4\}$
b) $\{x \in \mathbb{R} \mid x < 0 \text{ ou } x \geqslant 2, \text{ com } x \neq 4\}$

58. a) $\{x \in \mathbb{R} \mid x \leqslant -2 \text{ ou } 0 < x \leqslant 6\}$
b) $\{x \in \mathbb{R} \mid -1 < x < 0 \text{ ou } x > 1\}$
c) $\{x \in \mathbb{R} \mid x > 2\}$

59. a) $D = \{x \in \mathbb{R} \mid -1 \leqslant x \leqslant 3 \text{ ou } x \geqslant 5\}$
b) $D = \{x \in \mathbb{R} \mid x < -\sqrt{2} \text{ ou } \sqrt{2} < x \leqslant 2\}$
c) $D = \{x \in \mathbb{R} \mid -1 < x \leqslant 0 \text{ ou } x > 1\}$

60. $\{m \in \mathbb{R} \mid -4 < m < 4\}$

61. $\{m \in \mathbb{R} \mid -3 < m < 0\}$

62. $\nexists\, m \in \mathbb{R}$ que satisfaz.

63. $m = -7$

64. $\{m \in \mathbb{R} \mid m < -2\}$

TESTES DE VESTIBULARES

1. d
2. c
3. e
4. c
5. a) F b) F c) F d) F e) V
6. a
7. a
8. a
9. e
10. e
11. a
12. d
13. a
14. b
15. d
16. a
17. a
18. d
19. a
20. a
21. e
22. a
23. b

5 FUNÇÃO MODULAR

EXERCÍCIOS

1. a) −1 b) −1 c) −1 d) 1 e) 1

2. a) 1 b) 10 c) 41

3. a) R$ 480,00, R$ 1 400,00 e R$ 2 700,00
b) $y = \begin{cases} 12 \cdot x, \text{ se } x \leqslant 100 \\ 10 \cdot x + 200, \text{ se } x > 100 \end{cases}$

4. a) R$ 480,00, R$ 1 200,00 e R$ 2 500,00
b) $y = \begin{cases} 12 \cdot x, \text{ se } x \leqslant 100 \\ 10 \cdot x, \text{ se } x > 100 \end{cases}$

5. *f* não tem raízes reais.

6. a) 3 b) 2 c) −8 d) −2 ou $\sqrt{6}$

7. a) *A*: R$ 360,00; *B*: R$ 735,00; *C*: R$ 960,00
b) *A*: R$ 90,00; *B*: R$ 81,67; *C*: R$ 80,00
c) $y = \begin{cases} 90 \cdot x, \text{ se } x \leqslant 4 \\ 75 \cdot x + 60, \text{ se } 4 < x \leqslant 12 \end{cases} \quad (x \in \mathbb{N})$

8. a) R$ 49,50 b) 6 peças

9. a) $Im = \{-1, 2\}$
b) $Im = \{y \in \mathbb{R} \mid y \geqslant 2\}$
c) $Im = \{y \in \mathbb{R} \mid y = 4 \text{ ou } y \leqslant -2\}$

10. a) Im = {1, 2,3}

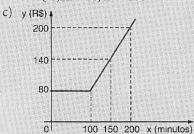
b) Im = $\{y \in \mathbb{R} \mid y \geq 3\}$

c) Im = $\{y \in \mathbb{R} \mid y \geq 0\}$

11. a) $y = \begin{cases} 3, \text{ se } x \geq -1 \\ -2, \text{ se } x < -1 \end{cases}$ b) $y = \begin{cases} 3x, \text{ se } x \geq 0 \\ 0, \text{ se } x < 0 \end{cases}$

12. a) R\$ 80,00; R\$ 140,00

b) $y = \begin{cases} 80; x \leq 100 \\ 1{,}2x - 40; x > 100 \end{cases}$

c)

13. a) $f(x) = \begin{cases} x + 1, \text{ se } x \geq 1 \\ -2x + 4, \text{ se } x \leq 1 \end{cases}$

b) $S = \left\{4, -\frac{1}{2}\right\}$

14. a) 7 e) $\sqrt{2}$ i) $\frac{1}{2}$

b) $\frac{5}{3}$ f) 6 j) $\frac{3}{4}$

c) $\frac{1}{2}$ g) 0,2

d) 0 h) 0,2

15. a) $\sqrt{11} - \sqrt{7}$ c) $\sqrt{10} - 3$ e) $2\sqrt{40} - 12$

b) $\pi - 3$ d) 1

16. E = 3

17. a) V

b) F; $|x + 3| = x + 3$ quando $x \geq -3$.

c) F; $|2x - 1| = 2x - 1$ quando $x \geq \frac{1}{2}$.

d) V

e) V

18. a) –1 b) 4 c) 2

19. a) 11 b) 14 c) 2 d) 31

20. a) –3 b) 21 c) 22 d) 16

21. a) $-12x + 1$ c) $9x - 8$

b) $-12x + 9$ d) $16x - 3$

22. $-\frac{10}{3}$

23. a) $S = \left\{0, \frac{1}{2}\right\}$ b) S = {–3} c) $S = \varnothing$

24. $g(x) = 3x + 5$

25. $f(x) = 5x - 2$

26. a) V b) F c) V d) F e) F

27. 5

28. a) 50 000; R\$ 460,00

b) R\$ 514,00

c) $s(t) = 2{,}4t^2 - 1{,}2t + 460$

29. a)

c)

b)

d)

30. a)

c)

b)

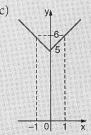
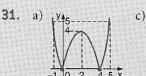
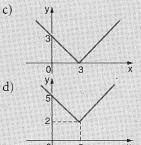
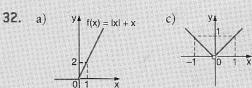
31. a)

c)

b)

d)

32. a)

c)

b) Im = $\{y \in \mathbb{R} \mid y \geq 1\}$

33. 5; x = 3

34. raízes: 1 e 3
Im = {y ∈ ℝ | y ≥ 0}

35. a) S = {–6, 6} d) S = {–3, 3}
b) $S = \left\{-\frac{2}{9}, \frac{2}{9}\right\}$ e) S = {–2, 2}
c) S = ∅

36. a) $S = \left\{1, \frac{1}{3}\right\}$ d) S = {–3, 3}
b) S = {–2, –10} e) $S = \left\{\frac{1}{2}, 2\right\}$
c) $S = \{-2, 4, 1 - \sqrt{3}, 1 + \sqrt{3}\}$

37. a) $S = \left\{\frac{5}{3}, 5\right\}$ d) S = {1, –4}
b) $S = \left\{\frac{3}{2}, -\frac{1}{4}\right\}$ e) $S = \left\{\frac{3}{2}\right\}$
c) S = { }

38. a) S = {–5, 5} c) S = {0, –2, 2}
b) S = {–4, –6, 4, 6} d) S = {1, 2}

39. a) 760 pessoas c) dia 25; 300 pessoas
b) dias 20 e 30

40. a) S = {–2, 3} c) S = {3, –9}
b) $S = \{-\sqrt{5}, \sqrt{5}, -\sqrt{3}, \sqrt{3}\}$

41. a) S = {–2, 4} b) $S = \left\{\frac{3}{2}\right\}$

42. a) {x ∈ ℝ | x < –6 ou x > 6}
b) {x ∈ ℝ | –4 ≤ x ≤ 4}
c) $\left\{x \in \mathbb{R} \mid -\frac{1}{2} < x < \frac{1}{2}\right\}$
d) $\{x \in \mathbb{R} \mid x \leq -\sqrt{2} \text{ ou } x \geq \sqrt{2}\}$
e) $\left\{x \in \mathbb{R} \mid -\frac{7}{3} \leq x \leq \frac{7}{3}\right\}$
f) S = ℝ

43. a) {x ∈ ℝ | x < –10 ou x > 4}
b) {x ∈ ℝ | –1 ≤ x ≤ 2}
c) {x ∈ ℝ | x ≤ 0 ou x ≥ 2}
d) $\left\{x \in \mathbb{R} \mid -\frac{9}{5} < x < 3\right\}$
e) S = ∅
f) $S = \mathbb{R} - \left\{-\frac{5}{2}\right\}$

44. a) {x ∈ ℝ | –2 ≤ x ≤ –1 ou 2 ≤ x ≤ 3}
b) {x ∈ ℝ | x < –1 ou 2 < x < 3 ou x > 6}
c) {x ∈ ℝ | x < –1 ou x > 2}

45. a) janeiro, novembro e dezembro b) junho; 3

46. a) $\left\{x \in \mathbb{R} \mid x \leq \frac{1}{3} \text{ ou } x \geq 1\right\}$
b) {x ∈ ℝ | x < 1}

47. a) D = {x ∈ ℝ | x ≠ –7 e x ≠ 7} d) D = ℝ
b) D = {x ∈ ℝ | x ≤ –2 ou x ≥ 2}
c) D = {x ∈ ℝ | –5 ≤ x ≤ 5}

TESTES DE VESTIBULARES

1. b
2. a) V b) V c) F d) F e) F
3. b
4. b
5. d
6. c
7. b
8. c
9. a
10. d
11. d
12. b
13. b
14. a
15. c
16. b
17. e
18. a
19. c

6 FUNÇÃO EXPONENCIAL

EXERCÍCIOS

1. a) 343 d) $\frac{1}{16}$ g) –625
b) –125 e) $-\frac{243}{32}$ h) $-\frac{8}{27}$
c) 16 f) –4 i) 27

2. a) –5 c) 128 e) $\frac{243}{10}$
b) $\frac{63}{8}$ d) $-\frac{15}{4}$

3. a) 11^6 c) 3^4 e) $x^9 \cdot y^8$
b) $1 = 2^0$ d) $x^4 \cdot y^2$

4. a) 2^{49} c) 2^{22} e) 5^{60}
b) 3^{46} d) 10^{28} f) 3^{59}

5. a) $\frac{1}{16}$ d) $\frac{16}{9}$ g) –3
b) $\frac{1}{3}$ e) 625 h) 1 000
c) 8 f) $\frac{9}{4}$ i) 125

6. a) $\frac{43}{72}$ c) –5 e) –1
b) $\frac{40}{9}$ d) $-\frac{3}{2}$

7. a) $a^9 \cdot b^{-10}$ c) $a \cdot b^{-1}$
b) $a^{14} \cdot b^{12}$ d) $a^{-1} \cdot b^{-1}$

8. $\frac{1}{2}$

9. a) 6 b) 30 c) $\frac{19}{3}$ d) 100

10. a) $\frac{1}{a}$ b) $\sqrt{a}$ c) a^2 d) $\sqrt{a}$

11. a) 13 c) $\frac{1}{2}$ e) $\frac{1}{2}$
b) 8 d) $\frac{1}{2}$ f) 10

12. a) $3\sqrt{2}$ c) $3\sqrt[3]{2}$ e) $2\sqrt[4]{15}$
b) $3\sqrt{6}$ d) $12\sqrt{2}$ f) 0,05

13. a) $9\sqrt{2}$ c) $4\sqrt[3]{2}$
b) $-8\sqrt{2} + 2\sqrt{3}$ d) $21\sqrt{3}$

14. a) 5 b) $\frac{5\sqrt[3]{2}}{2}$ c) 16 d) $\sqrt{2}$

15. a) 12 c) 4 e) 3
b) $4\sqrt{3}$ d) 3

16. a) $4 + 2\sqrt{3}$ c) $7 + 2\sqrt{10}$ e) $\sqrt{3} + 2\sqrt[4]{3} + 1$
b) $11 - 6\sqrt{2}$ d) 9 f) $20 + 14\sqrt{2}$

17. a) 2 b) 7 c) 2 d) 4

18. a) $2\sqrt{2} - 2$ c) $2 + \sqrt{2}$ e) $2 + \sqrt{2}$
b) $\sqrt{7} + \sqrt{3}$ d) $\frac{7 - 2\sqrt{10}}{3}$

19. a) $\frac{7\sqrt{2}}{2}$ b) $4 - \sqrt{2}$ c) $5 + \frac{2\sqrt{3}}{3}$

20. a) $\frac{\sqrt[3]{4}}{2}$ c) $-\sqrt[7]{27}$
b) $5\sqrt[5]{125}$ d) $\frac{2\sqrt{3} + 3\sqrt{2} + \sqrt{30}}{12}$

22. a) 3 c) 2 e) $\frac{1}{10}$ g) 9
b) 16 d) 0,6 f) 4 h) $\frac{1}{8}$

23. a) $2\sqrt{2}$ d) 27 g) 2
b) $\sqrt{2}$ e) $\frac{1}{8}$ h) $81\sqrt{3}$
c) $\frac{1}{10}$ f) 1 024

24. 5

25. a) $\frac{25\sqrt{2}}{2}$ b) 35 s; 50 s

26. a)

b)

c)

d)

27. 3

28. a)

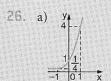
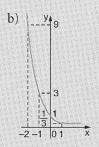
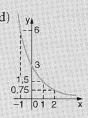
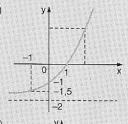
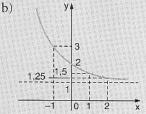
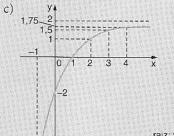
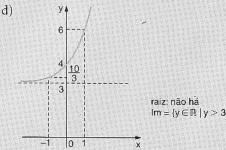
raiz: x = 1
$Im = \{y \in \mathbb{R} \mid y > -2\}$

b)

raiz: não há
$Im = \{y \in \mathbb{R} \mid y > 1\}$

c)

raiz: x = 1
$Im = \{y \in \mathbb{R} \mid y < 2\}$

d)

raiz: não há
$Im = \{y \in \mathbb{R} \mid y > 3\}$

29. a) a = 1; b = 2 b) $Im = \{y \in \mathbb{R} \mid y > 1\}$ c) $\frac{3}{2}$

30. 60%

31. a)

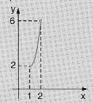
Anos	1	2	3	4	5
População	105 000	110 250	115 762	121 550	127 627

b) $p_1 = p_0 \cdot 1{,}05$; $p_2 = p_0 \cdot 1{,}05^2$; $p_3 = p_0 \cdot 1{,}05^3$; $p_4 = p_0 \cdot 1{,}05^4$
c) $p_n = p_0 \cdot 1{,}05^n$; função exponencial

32. a) 188 778 978 habitantes
b) 207 642 322 habitantes

33. verdadeira

34. a) 552 peças b) 300; sim

35. a) 54; 162
b) 242
c) $y = 2 \cdot 3^{x-1}$
d) 432 trilhões de membros

36. a) $S = \{4\}$ b) $S = \{8\}$ c) $S = \{1\}$ d) $S = \{5\}$ e) $S = \{1\}$ f) $S = \left\{\frac{5}{3}\right\}$ g) $S = \{4\}$ h) $S = \{-1\}$

37. a) $S = \left\{\frac{4}{3}\right\}$ b) $S = \left\{\frac{2}{3}\right\}$ c) $S = \left\{-\frac{3}{2}\right\}$ d) $S = \{-3\}$ e) $S = \left\{\frac{13}{2}\right\}$ f) $S = \left\{2, \frac{1}{2}\right\}$ g) $S = \left\{-\frac{5}{6}\right\}$ h) $S = \left\{\frac{27}{7}\right\}$

38. a) 0,155 g b) 11 dias

39. a) 1,5 ano b) 4,5 anos c) 9 anos

40. a) $S = \{-14\}$ b) $S = \{-1\}$ c) $S = \left\{-\frac{1}{2}, -2\right\}$ d) $S = \left\{\frac{2}{3}\right\}$

41. a) $S = \{(1, -2)\}$ b) $S = \{(8, 18)\}$ c) $S = \{(0, 2)\}$

42. a) $S = \{3\}$ b) $S = \{0\}$ c) $S = \{2\}$ d) $S = \{-1\}$

43. a) *A*: 122 mil reais
B: 249,5 mil reais
b) B c) 8 anos

44. a) −1
b) 33 750 habitantes

45. a) $S = \{2\}$ b) $S = \{1\}$ c) $S = \{3, -2\}$ d) $S = \{3\}$

46. a) $x = 0$ ou $x = -1$
b) $-12 < m < 0$

47. a) 10% b) 2 horas

48. a) $\{x \in \mathbb{R} \mid x \geqslant 7\}$ b) $\{x \in \mathbb{R} \mid x < 3\}$ c) $\{x \in \mathbb{R} \mid x > 2\}$ d) $\{x \in \mathbb{R} \mid x \leqslant 2\}$ e) $\left\{x \in \mathbb{R} \mid x > \frac{5}{2}\right\}$ f) $\left\{x \in \mathbb{R} \mid x > -\frac{1}{3}\right\}$

49. a) $\{x \in \mathbb{R} \mid x \geqslant 0\}$ b) $\left\{x \in \mathbb{R} \mid x < \frac{2}{3}\right\}$ c) $\{x \in \mathbb{R} \mid x \leqslant -8\}$ d) $\left\{x \in \mathbb{R} \mid x < -\frac{1}{4}\right\}$ e) $\left\{x \in \mathbb{R} \mid x \geqslant \frac{5}{2}\right\}$ f) $\{x \in \mathbb{R} \mid x > 1\}$

50. a) 4 995 b) $t > 4$ c) sim

51. a) $\{x \in \mathbb{R} \mid x < 1 \text{ ou } x > 2\}$
b) $\left\{x \in \mathbb{R} \mid 0 < x < \frac{2}{3}\right\}$
c) $\{x \in \mathbb{R} \mid x \leqslant -\sqrt{5} \text{ ou } x \geqslant \sqrt{5}\}$
d) $S = \mathbb{R}$

52. a) $\{x \in \mathbb{R} \mid x \geqslant 4\}$ b) $\{x \in \mathbb{R} \mid x > -3\}$

53. a) $\{x \in \mathbb{R} \mid 0 < x < 1\}$ b) $\{x \in \mathbb{R} \mid x < 1 \text{ ou } x > 3\}$ c) $S = \varnothing$

54. a) R$ 2 000,17 b) 12

TESTES DE VESTIBULARES

1. e
2. a) F b) F c) F d) F e) V
3. a
4. e
5. b
6. c
7. c
8. a
9. d
10. a
11. a
12. a
13. a
14. d
15. c
16. e
17. a
18. c
19. c
20. c
21. a
22. d
23. b
24. a) F b) F c) V d) F
25. d

7 FUNÇÃO LOGARÍTMICA

EXERCÍCIOS

1. a) 4 b) 2 c) 4 d) 3 e) 5 f) 2 g) 5 h) 3

2. a) −2 b) $\frac{1}{2}$ c) $\frac{4}{3}$ d) $\frac{7}{2}$ e) $\frac{1}{4}$ f) −2 g) $-\frac{3}{2}$ h) $-\frac{2}{3}$

3. a) $-\frac{2}{3}$ b) $\frac{1}{6}$ c) $-\frac{3}{4}$ d) 3 e) $\frac{1}{9}$ f) 4

4. a) 0 c) 1 e) $\frac{1}{3}$
b) −2 d) 5 f) $\frac{3}{2}$

5. a) −2 c) −1 e) 3
b) $-\frac{1}{2}$ d) 1 f) −4

6. a) 2 b) $\frac{1}{4}$

7. a) −2 b) $\frac{1}{7}$ c) 12 d) $-\frac{4}{9}$ e) −1

8. a) 128 c) 343 e) 16
b) $\frac{5}{4}$ d) 3 f) $\sqrt{7}$

9. m = 16; −2

10. a) 1 c) 0 e) $-\frac{3}{2}$
b) −5 d) 7 f) 4

11. a) a + b e) −2a i) 3a + b − 3
b) b − a f) 3a + 2b j) b − 2a
c) 1 − a g) b − 1
d) b + 1 h) $\frac{2}{3}b + \frac{1}{3}a - \frac{1}{3}$

12. a) $x = a \cdot b \cdot c$ d) $x = \frac{a \cdot b^2}{3c}$
b) $x = \frac{a}{b}$ e) $x = a^2 \cdot b$
c) $x = \frac{2 \cdot a^3 \cdot c^2}{b}$

13. a) 1 b) −1 c) 1 d) −2

14. a) 1,86 c) 0,69 e) −1,22 g) 2,1
b) −1,26 d) 0,72 f) 1,68

15. 2,66

16. a) 2,243 b) 1,146 c) −0,0973

17. a) 1,2 b) 12

18. a) $\frac{p}{3} + \frac{q}{2}$ c) $\frac{2q}{3} + \frac{p}{9}$ e) $\frac{p}{9} + \frac{2q}{3}$
b) p + q − 2 d) $\frac{3q}{2} - \frac{2p}{3}$

19. sim

20. a) 1 + m c) 15m
b) $\frac{3m}{2}$ d) 15m + 20

21. 1

22. a) $\frac{\log_2 3}{\log_2 5}$ c) $\frac{2}{\log_2 3}$
b) $\frac{\log_2 5}{\log_2 10}$ d) $\frac{\log_2 3}{\log_2 e}$

23. a) 0,625 b) 0,686 c) $2,\overline{3}$ d) $4,1\overline{6}$

24. a) $\frac{1}{2}$ b) $\frac{1}{3}$ c) $\frac{1}{2}$ d) 1

25. a) $\frac{1}{a}$ b) $\frac{1}{2a}$ c) $\frac{1+a}{a}$

26. a) $\log_6 3$ b) 1

29. a) $T = \frac{2S}{3}$
b) *T*, pois $3 < S < 4$ e $2 < T < \frac{8}{3}$.

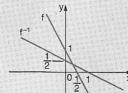
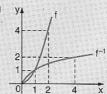
30. S **31.** B **32.** I

33. O **34.** I **35.** B

36. a, d, e

37. sobrejetoras: *a*, *b*, *c* e *d*; bijetoras: *b* e *c*

38. a) sim; $f^{-1}(x) = \frac{x-3}{2}$
b) não, *f* não é injetora.
c) sim; $f^{-1}(x) = \frac{1}{x}$
d) sim; $f^{-1}(x) = \log_2 x$
e) sim; $f^{-1}(x) = 1 + 3^x$
f) não; *f* não é injetora nem sobrejetora.

39. a) $f^{-1}(x) = \frac{1-x}{2}$
b)

40. a) $f^{-1}(x) = \sqrt{x}$
b)

41. 1

42. a) $f^{-1}(x) = \frac{3+5x}{4}$ c) $f^{-1}(x) = \frac{2+3x}{1-x}$
b) $f^{-1}(x) = \sqrt[3]{x}$

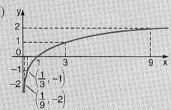
43. a) $f(x) = 2x + 1$ b) (−1, −1)
$f^{-1}(x) = \frac{x-1}{2}$

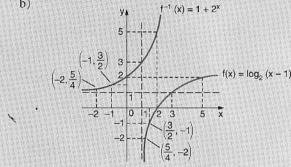
44. a) V c) F; $f(10 \cdot x) = 1 + f(x)$
b) V d) V

45. a) $D = \{x \in \mathbb{R} \mid x > 1\}$
b) $D = \left\{x \in \mathbb{R} \mid x > \frac{2}{3}\right\}$
c) $D = \{x \in \mathbb{R} \mid x < -3 \text{ ou } x > 3\}$

46. a) 425 b) 25

47. a)
b)

c)

48. $a = 3; b = 2$

49. $\frac{1}{2}$

50. a) $D = \{x \in \mathbb{R} \mid x > 1\}$
b)
51. a) V
b) F; a inversa de C é $y = 2^{x-2} - 1$.
c) V
d) F; 33,3% de aumento.
e) V
f) V

52. a) 1 000 b) 7

53. a) V c) F e) F g) V
b) F d) V f) F h) V

54. Como $0 < a < 1$ e $2c^2 > 1$, então $\log_a 2c^2 < 0$. Pelo gráfico, $c > 0$, então $(-c) \cdot (\log_a 2c^2)$ é positivo.

55. a) $S = \{2{,}08\overline{3}\}$ e) $S = \{2{,}\overline{3}\}$
b) $S = \{0{,}8\}$ f) $S = \{0{,}625\}$
c) $S = \{4{,}8\}$ g) $S = \{2{,}2\}$
d) $S = \{0{,}78\}$ h) $S = \{1{,}6\}$

56. 4,5 anos

57. a) R$ 531,00, aproximadamente
b) 50 meses (4 anos e 2 meses); 75 meses

58. a) R$ 80 000,00 c) 30 anos
b) R$ 8 000,00

59. a) $\frac{2}{3}$ b) R$ 500,00 c) 5 anos

60. a) 1,5 ano b) 3,75 anos

61. 7

62. 3 000 m

63. a) $S = \{3\}$ d) $S = \left\{\frac{11}{6}\right\}$
b) $S = \{3\}$ e) $S = \{3\}$
c) $S = \{3, 7\}$

64. a) $S = \{13\}$ c) $S = \{3\}$ e) $S = \{4\}$
b) $S = \left\{1, \frac{1}{2}\right\}$ d) $S = \left\{\frac{1}{32}\right\}$

65. a) $S = \left\{\frac{1}{8}, 32\right\}$ c) $S = \left\{1, 8, \frac{1}{64}\right\}$
b) $S = \left\{\frac{1}{10}, \sqrt{10}\right\}$

66. a) altura: 100 cm b) 20 cm
diâmetro: 10 cm

67. a) $S = \{4\}$ c) $S = \{1\}$
b) $S = \{6\}$ d) $S = \left\{\frac{1}{10}\right\}$

68. a) $S = \{2\}$ b) $S = \{2\}$ c) $S = \left\{\frac{9}{8}\right\}$ d) $S = \{4\}$

69. a) $S = \{(8, 2), (2, 8)\}$ c) $S = \{(2, 2)\}$
b) $S = \left\{\left(3, \frac{1}{3}\right)\right\}$

70. $t = 2$

71. a) $S = \left\{\frac{1}{5}, 5\right\}$ c) $S = \{7\}$
b) $S = \left\{7, \frac{1}{49}\right\}$ d) $S = \left\{\frac{3 + \sqrt{5}}{2}\right\}$

72. 8

73. 8 meses

74. $x = 4; y = 1$

75. $S = \left\{9, \frac{1}{9}\right\}$

76. a) $\{x \in \mathbb{R} \mid x > \log_3 4\}$
b) $\left\{x \in \mathbb{R} \mid x > \log_2 \frac{1}{3}\right\}$
c) $\{x \in \mathbb{R} \mid x < \log_{0,3} 2\}$
d) $\left\{x \in \mathbb{R} \mid x \geq \log_{10} \frac{1}{5}\right\}$

77. a) $\{x \in \mathbb{R} \mid x > 0{,}8\}$
b) $\{x \in \mathbb{R} \mid x > -3{,}2\}$

78. a) $\{x \in \mathbb{R} \mid 1 < x < 4\}$
b) $\{x \in \mathbb{R} \mid x \geqslant 2\}$
c) $\{x \in \mathbb{R} \mid x > 6\}$
d) $\left\{x \in \mathbb{R} \mid \frac{3}{2} \leqslant x < 3\right\}$

79. a) $\{x \in \mathbb{R} \mid x > 9\}$
b) $\{x \in \mathbb{R} \mid 0 < x < 4\}$
c) $\left\{x \in \mathbb{R} \mid 0 < x < \frac{1}{4}\right\}$
d) $\left\{x \in \mathbb{R} \mid 0 < x \leqslant \frac{2}{5}\right\}$

80. nenhum

81. $\{m \in \mathbb{R} \mid 0 < m < 3\}$

82. a) $\sqrt{6}$ b) $D = \{x \in \mathbb{R} \mid x \geqslant 3\}$

83. a) $\{x \in \mathbb{R} \mid 3 \leqslant x < 13\}$
b) $\{x \in \mathbb{R} \mid x > 5\}$

84. $\left\{x \in \mathbb{R} \mid 0 < x \leqslant \frac{1}{3} \text{ ou } x \geqslant 27\right\}$

85. $\left\{x \in \mathbb{R} \mid 0 < x < \frac{1}{16} \text{ ou } x > 2\right\}$

86. 5

TESTES DE VESTIBULARES

1.	c	9.	a	17.	b	25.	d
2.	d	10.	d	18.	c	26.	a
3.	a	11.	d	19.	a	27.	b
4.	a	12.	d	20.	c	28.	c
5.	b	13.	c	21.	a	29.	c
6.	e	14.	c	22.	b	30.	d
7.	b	15.	b	23.	b	31.	e
8.	b	16.	d	24.	d		

8 PROGRESSÕES

EXERCÍCIOS

1. (6, 11, 18, 27)

2. a) 7 b) 17 c) 52

3. a) sim; 5º termo
b) não
c) não
d) sim; 48º termo

4. a) (–5, –7, –11, –19, ...) b) (0, –2, 2, 2, 2)

5. a) 19º termo: 47
b) 13º termo: 5
c) 35º termo: –1

6. a) (1, 1, 2, 3, 5, 8, ...)
b)

7. a, c, d, f

8. a) –3; decrescente
b) 6; crescente
c) 0; constante
d) –10; decrescente
e) $\frac{2}{3}$; crescente
f) 1; crescente

9. a) –84 b) –232

10. a) 4 b) –13 c) $a_{20} = 3$

11. a) $a_n = 5n - 5$
b) $a_n = -10 + 6n$
c) $a_n = 87 - 4n$

12. a) $a_n = 3n$ b) 180

13. (–9, 2, 13, 24, 35, ...)

14. a) –10 b) 52

15. (–8, –20, –32, –44)

16. 38 minutos

17. a) R$ 280,00 b) R$ 4 560,00

18. a) 102 b) 414

19. a) 6 b) 10 c) 4 ou $-\frac{1}{2}$

20. a) 63 b) 49

21. a) 83 b) 41,5

22. a) (62, 67, 72, 77, 82, 87, 92, 97)
b) (52, 48, 44, 40, 36, 32, 28, 24, 20, 16)

23. 198

24. 162

25. a) 100 b) 140

26. 167 funcionários

27. a) log 2 b) 10^{-6}

28. 50 meses

29. 28; 6

30. 24

31. a) (20, 24, 28) b) (28, 24, 20)

32. (9, 6, 3)

33. x = 24 cm; y = 32 cm; z = 40 cm

34. 20

35. a) Os possíveis valores inteiros de *b* são –2, –1, 0 e 1.
b) $b = -2 \rightarrow \left(-\frac{1}{2} \text{ e } 0\right)$; $b = -1 \rightarrow \left(\frac{-1 \pm \sqrt{13}}{6}\right)$;
$b = 0 \rightarrow (-1 \text{ e } 1)$ e $b = 1 \rightarrow \left(\frac{1 \pm \sqrt{13}}{2}\right)$

36. –255

37. a) plano alfa b) R$ 325,00

38. a) 318 b) 92

39. a) 495 b) 2,5%

40. a) 145,5 b) –190,8

41. a) 15 b) –6 c) –39

42. 26 fileiras

43. L = 12,8 m

44. a) 19 b) 50 c) no mínimo 48

45. $\left(\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, ...\right)$

46. 17

47. 4 cm

48. a) 99 b) 9 801

49. 1 275

50. a, b, d, e

51. a) 2 c) –4 e) $\frac{1}{2}$
b) 100 d) –1 f) $\frac{1}{10}$

52. a) 1 024 b) 16 384

53. $\frac{2}{5}$

54. –320

55. a) $a_n = 2 \cdot 3^{n-1}$
b) $a_n = 3^{30-3n}$
c) $a_n = (-2) \cdot (-4)^{n-1}$

56. a) R$ 64,00 b) R$ 729,00

57. 54

58. a) q = 3 b) 27 c) 8

59. (1 000, 200, 40, 8, ...) ou (40, 200, 1 000, 5 000, ...)

60. 729 m²

61. a) 4 cm b) $q = \sqrt{2}$

62. a) 21 b) 8 c) 10

63. a) $\frac{1}{10}$ b) 20

64. a) –6 ou 6 b) 10 c) 1 ou 5

65. a) 6,5 b) $\frac{1}{3}$

66. (3, 6, 12)

67. a) 256 b) 1,28 m

68. sim; 16

69. a) $\ell = 8$ cm e $h = 4\sqrt{3}$ cm
b) $A_2 = 4\sqrt{3}$ cm² e $A_7 = \frac{\sqrt{3}}{256}$ cm²

70. –2; q = 16

71. a) $\frac{1}{4}$ b) sim; 7º termo

72. 14

73. a) $\frac{3}{2}$ b) $\frac{135}{2}$

74. (a = 36 e b = 24) ou (a = 4 e b = 8)

75. $a_n = (7, 10, 13, 16, ...)$ é P.A.; r = 3
$b_n = (2^7, 2^{10}, 2^{13}, 2^{16}, ...)$ é P.G.; q = 8

76. 77

77. 42

78. a) 10 b) 2 046 c) $\frac{1\,023}{1\,024}$

79. a) $\frac{3\,280}{27}$ b) 11 111,11

80. R$ 1 536,00

81. R$ 8 500,00

82. a) –9 b) 182

83. a) 2 048 b) 9 840

84. a) US$ 1 092,25
b) US$ 321,00; prejuízo de US$ 771,25
c) US$ 303,95

85. a) 40 b) 100 c) $\frac{1}{900}$ d) $-\frac{125}{4}$

86. a) $\frac{4}{9}$ b) $\frac{16}{9}$ c) $\frac{3}{11}$ d) $\frac{71}{30}$

87. 1,44 m

88. a) $S = \left\{\frac{1}{2}, -\frac{2}{3}\right\}$ b) S = {2} c) $S = \left\{\frac{5}{3}\right\}$

89. 2 · S

90. a) $\frac{400}{9}$ cm b) $\frac{10\,000}{99}$ cm²

91. a) $\ell = 36$ cm b) $432\sqrt{3}$ cm²

TESTES DE VESTIBULARES

1. d
2. b
3. d
4. d
5. c
6. e
7. a
8. a
9. a
10. c
11. a) V b) V c) V d) F e) F
12. a) F b) V c) V d) F e) F
13. a
14. b
15. c
16. c
17. b
18. a
19. d
20. d
21. c
22. c
23. *a, c, e*
24. d
25. a
26. c

9 MATEMÁTICA FINANCEIRA

EXERCÍCIOS

1. a) 3,2 c) 4 e) 2
   b) $\frac{1}{3}$ d) 20 f) 30

2. a) a = 12; b = 32; c = 8; d = 52
   b) $\frac{5}{2}$ c) $\frac{13}{7}$ d) $\frac{1}{6}$ e) 4

3. a) $\frac{9}{2}$ b) $\frac{5}{7}$ c) −1 d) 0 ou $\frac{7}{2}$

4. 150 5. 20

6. R$ 1 000,00 a *P* e R$ 800,00 a *Q*

7. ouro: 11; prata: 22 e bronze: 44

8. a) 48 ℓ b) $\frac{3}{8}$

9. a) 21 voltas b) 192,5 ℓ

10. a) 6 000 b) 8 000

11. a) 12 c) 56 e) 2 g) 6,25
    b) 50 d) 108 f) 5,7 h) 126

12. a) R$ 50,40 c) R$ 40,80
    b) R$ 57,60 d) R$ 44,88

13. a) 8 547 000 km² c) 30,55 hab./km²
    b) 18,26%

14. a) 16 b) 60%

15. 28% 16. 20%

17. a) 25 b) 5 c) 80 d) 34

18. 10% 19. a) 610 b) 4,6875%

20. a) 80%
    b) Não; é necessário conhecer as quantidades totais de grãos produzidos nos dois Estados.

21. a) R$ 480,00 b) R$ 576,00

22. 10 g 23. 36% 24. x = 250

25. a) decréscimo de 12,5% c) acréscimo de 22,5%
    b) acréscimo de 40%

26. a) 80%, 16% e 4% b) 5

27. a) 33% b) 31,43% c) 25,38%

28. a) R$ 91,00 b) R$ 63,70

29. a) 12,5% b) R$ 3,12

30. a) 4,17x b) 13,73% 31. R$ 7 000,00

32. 4,418 milhões 33. a) R$ 432,00 b) 44%

34. 43,3% 35. a) 25% b) 6,25%

36. a) R$ 26,40 c) R$ 76,80
    b) R$ 324,00 d) R$ 235,20

37. a) R$ 480,00 b) R$ 352,80 c) R$ 6 125,00

38. a) R$ 8 000,00 b) R$ 12 800,00

39. a) 5% b) R$ 777,00 40. 5% a.m.

41. a) 20 meses b) 40 meses c) 180 meses

42. C = R$ 8 000,00

43. a) R$ 2 328,00 b) 6,38% 44. 25% a.m.

45. a) R$ 7 280,00 b) 45,6% 46. 21

47. a) M = R$ 324,73; J = R$ 24,73
    b) M = R$ 4 489,64; J = R$ 1 989,64
    c) M = R$ 156,09; J = R$ 56,09

48. a) R$ 540,88 49. a) 410
    b) R$ 608,76 b) R$ 492,00

50. 20% a.m. 51. a) 6,5 meses b) 17,5 meses

52. a) 10% a.m. b) R$ 354,31 53. n = 12

54. a) 3,75 anos c) 8,75 anos
    b) 6 anos d) 12 anos

55. a) R$ 1 023,78 b) 27,97%

56. a) R$ 109,31 b) 9,31% c) R$ 125,56

57. a) R$ 5 670,00 b) 13,4%

58. a) F b) V c) F d) V e) V

59. a) R$ 120 000,00 c) 10%
    b) R$ 10 800,00 d) 45 anos

60. a) $v \cdot v_0 \cdot 0{,}95^t$ b) 22,6% c) 28 anos

61. 30%

TESTES DE VESTIBULARES

1. b 8. e 15. d 22. c
2. b 9. d 16. d 23. d
3. d 10. b 17. b 24. d
4. c 11. c 18. a 25. e
5. e 12. d 19. e 26. c
6. a 13. a 20. e
7. b 14. e 21. c

10 SEMELHANÇA DE TRIÂNGULOS

EXERCÍCIOS

1. a) $x = 90°; y = 8$ c) $x = \alpha; y = \frac{8}{3}$
b) $x = 8; y = 14$ d) $x = \frac{24}{5}; y = \frac{25}{4}$

2. 90°, 40° e 50°

3. a) Sim, os dois triângulos são eqüiláteros e, portanto, eqüiângulos.
b) $\frac{1}{2}$ ou 2
c) $\frac{1}{4}$ ou 4

4. a) 70°
b) São paralelos.
c) $\frac{4,5}{1,5} = \frac{6}{2} = \frac{p}{DE} = 3; DE = \frac{p}{3}$

5. CE = 3 cm, AE = 6 cm, CG = 9 cm

6. $\frac{2}{3}$ **7.** $x = 3$ e $y = 12$ **8.** $\frac{32}{3}$ cm

9. São paralelos, pois $\hat{M} \equiv \hat{P}$ e $\hat{Q} \equiv \hat{R}$.

10. a) 6 b) $\frac{4}{5}$ **11.** $x = 28$ e $y = 5\sqrt{3}$

12. $\alpha; \frac{15}{2}$ **13.** $x = \frac{14}{3}; y = \frac{15}{2}$

14. I e IV; os lados são proporcionais.

15. a) 5 cm, 7 cm e 8 cm b) 120°

16. Sim; os ângulos de cada triângulo medem 35°, 55° e 90°.

17. $x = \sqrt{2}; y = 2$ **18.** $\frac{230}{13}$

19. a) São paralelos. b) $BE = \frac{CD}{2}$

20. $x = 5; y = \frac{5}{2}$ **21.** $\frac{60}{13}$ cm; $\frac{25}{13}$ cm

22. $5\sqrt{2}$ cm **23.** $10\sqrt{2}$ cm, $10\sqrt{3}$ cm e $10\sqrt{6}$ cm

24. Construção: basta traçar, por uma das extremidades do segmento dado, sobre uma perpendicular a ele, outro segmento de medida dobrada e unir as extremidades livres.

25. 6,72 m **26.** $12x^3$

27. $\frac{40\sqrt{130}}{7}$ cm **28.** a) $2\sqrt{3}$ cm b) $\frac{8\sqrt{3}}{3}$ cm

29. a) $5\sqrt{2}$ cm b) $10\sqrt{2}$ cm

30. a) 5, 12 e 13 **31.** c

32. a) 5, 12 e 13 c) 9, 40 e 41
b) 7, 24 e 25 d) 11, 60 e 61

33. a) $3\sqrt{3}$ b) 400 c) $\frac{25}{4}$ d) $\sqrt{105}$

34. $\frac{\sqrt{6}}{6}$ cm **35.** $2\sqrt{5}$ m **36.** 10 cm

37. 105 m **38.** $h = \frac{H}{2}$

39. $6\sqrt{2}$ km **40.** a) 3 m b) $3\sqrt{2}$ m

TESTES DE VESTIBULARES

1. c **2.** a **3.** b **4.** a) F b) V c) V d) F e) V **5.** e **6.** b **7.** d **8.** a **9.** a **10.** a **11.** a **12.** c **13.** a **14.** c **15.** c **16.** d **17.** a **18.** e **19.** e **20.** b **21.** c **22.** c **23.** b

11 TRIGONOMETRIA NO TRIÂNGULO RETÂNGULO

EXERCÍCIOS

1. $\frac{5}{13}$ e $\frac{12}{13}$

2. a) $\frac{2}{7}$ c) $\frac{7}{25}$
b) $\frac{5\sqrt{41}}{41}$ d) $\frac{7\sqrt{74}}{74}$

3. a) sen $\hat{B} \cong 0,788$ e sen $\hat{C} \cong 0,615$
b) $\hat{B} \cong 52°$ e $\hat{C} \cong 38°$

4. 25° e 65°

5. a) 6,69 cm c) 38,6°
b) 14,61 m d) 28,97 m

6. 5,14 cm **7.** 10,39 m; 6 m

8. $\frac{7}{25}$ e $\frac{24}{25}$

9. a) $\cos \hat{B} = \frac{4}{5}$ e $\cos \hat{C} = \frac{3}{5}$
b) $\cos \hat{B} = \frac{\sqrt{95}}{12}$ e $\cos \hat{C} = \frac{7}{12}$
c) $\cos \hat{B} = \frac{24}{25}$ e $\cos \hat{C} = \frac{7}{25}$
d) $\cos \hat{B} = \frac{60}{61}$ e $\cos \hat{C} = \frac{11}{61}$

10. a) 4,5 cm　c) 3,85 cm
b) $3\sqrt{3}$ cm　d) $3\sqrt{2}$ cm

11. $7\sqrt{1-a^2}$

12. a) 5 cm　c) 2,394 m
b) 4,528 m　d) 51°

13. $\frac{2\sqrt{10}}{7}$　14. $\frac{\sqrt{2}}{3}$　15. 40°

16. a) 3,35　b) $6\sqrt{3}$　c) 45,5°　d) 50°

17. $\frac{2\sqrt{2}}{3}$; $\frac{\sqrt{2}}{4}$　18. 1,1; 48°, aproximadamente

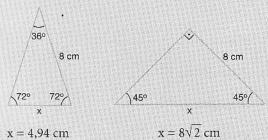
19. a) 4,76　b) 9,06　c) 6,88　d) 29,7°

20. $\frac{4}{5}$; 37°　21. 58°　22. $\sqrt{15}$

23. 19,5°; 70,5° e 90° ou 18,4°; 71,6° e 90°

24. x = 16,4 cm; y = 19,34 cm

25. *1º caso:*　*2º caso:*

x = 4,94 cm　$x = 8\sqrt{2}$ cm

26. a) $\frac{15}{4}$　c) $11\sqrt{2}$
b) 10　d) 5

27. a) 12　b) $\frac{\sqrt{3}}{2}$　c) 30°

28. V　29. 30° e 60°

30. $BC = 9(1 + \sqrt{3})$ e $AC = 9\sqrt{6}$; não

31. a) $3\sqrt{2}$　b) $8\sqrt{2}$　c) $\frac{11}{2}$　d) $7\sqrt{2}$

32. $20\sqrt{3}$ m　33. $x = 16$; $y = 8\sqrt{3}$

34. $\alpha = 58°$ e $\beta = 32°$

35. $\frac{15}{2}$ cm e $\frac{15\sqrt{3}}{2}$ cm　36. 1,5 m

37. a) $\text{tg}\,\alpha = 1$; $\text{tg}\,\beta = \frac{\sqrt{2}}{2}$; $\text{tg}\,\gamma = \frac{\sqrt{3}}{3}$
b) $\alpha = 45°$; $\gamma = 30°$

38. $2\sqrt{6}$ m

TESTES DE VESTIBULARES

1. b
2. d
3. d
4. c
5. a
6. d
7. b
8. b
9. a
10. d
11. c
12. b
13. c
14. a
15. a) V b) V c) F d) V
16. a
17. d
18. a) F b) F c) V d) V
19. e
20. d
21. a
22. c
23. c
24. a
25. b

12 TRIGONOMETRIA EM UM TRIÂNGULO QUALQUER

EXERCÍCIOS

1. $4\sqrt{6}$ cm

2. a) 3,07　c) $2 + \sqrt{6}$
b) 4,36　d) 2

3. a) $4\sqrt{2}$　b) 5,46　c) 2,07

4. 105°　5. $AB \cong 11{,}82$; $BC \cong 7{,}25$

6. $\hat{B} = 120°$; $\hat{C} = 45°$; $AB = \frac{5\sqrt{6}}{3}$ cm

7. 15,41　8. $x = \frac{9}{2}\sqrt{2}(1 + \sqrt{3})$ cm; $y = 9\sqrt{2}$ cm

9. a) 70 km　b) 42 km

10. a) $\sqrt{5}$　c) 8
b) $5\sqrt{3}$　d) $\frac{3\,599}{62}$ cm

11. 7 cm; 82° aproximadamente

12. isósceles e acutângulo

13. a) escaleno e obtusângulo
b) isósceles e acutângulo
c) escaleno e retângulo

14. 10,26 cm **15.** 3 cm ou 7 cm

16. x = 1 e y = 60°; o triângulo é retângulo em $\hat{C}$.

17. $2\sqrt{2}$ **18.** 5 cm **19.** 4,95

20. a) $\dfrac{\sqrt{3}}{4AB}$ b) $\dfrac{1+\sqrt{13}}{6}$

21. a) Os ângulos $\hat{A}$ e $\hat{B}$ medem (em qualquer ordem) x e 120° – x, constituindo, em conjunto com o ângulo de 60°, a P.A. (x, 60°, 120° – x), de razão igual a 60° – x, pois: (120° – x) – 60° = 60° – x

23. $\sqrt{5-3\sqrt{2}}$ cm; 54° e 96°, aproximadamente

TESTES DE VESTIBULARES

1. a	**6.** b	b) V	**13.** a) V
2. a	**7.** e	c) V	b) V
		d) F	c) F
3. e	**8.** a	e) V	d) V
4. e	**9.** c	**11.** d	**14.** b
5. e	**10.** a) V	**12.** e	**15.** b

13 O CICLO TRIGONOMÉTRICO

EXERCÍCIOS

1. a) 90° b) 157°30' c) 70° d) 77°30'

2. a) 145° b) 55° c) 141° d) 15°

3. 10° ou 350°

4. $\widehat{ACD} > \widehat{AMD} = \widehat{BCD} > \widehat{ABC} > \widehat{CD} > \widehat{AB}$

6. a) $\dfrac{\pi}{6}$ rad d) $\dfrac{7\pi}{6}$ rad g) $\dfrac{\pi}{9}$ rad
b) $\dfrac{\pi}{12}$ rad e) $\dfrac{3\pi}{2}$ rad h) $\dfrac{5\pi}{6}$ rad
c) $\dfrac{2\pi}{3}$ rad f) $\dfrac{5\pi}{3}$ rad

7. a) 60° c) 45° e) 108° g) 40°
b) 90° d) 36° f) 135° h) 330°

8. $70° < \dfrac{5\pi}{12}$ rad $< \dfrac{\pi}{2}$ rad $< 100° < \dfrac{7\pi}{12}$ rad

9. a) 10,4 m c) 1,25 m
b) 3,14 m d) 1 m

10. a) São iguais.
b) O primeiro é maior.

11. 16,74 cm

12. a) 62,8 m c) 3,14 m
b) 6,28 cm d) 6,57 m

13. a) 37,68 m b) 31,4 cm

14. a) 379,94 cm² b) 63,585 cm²

15. 12,56 unidades de comprimento

16. 17,27 cm **17.** $\dfrac{\pi}{4}$ rad

18. a) 17,9 cm b) 18 cm

19. a) O primeiro.
b) Os dois possuem o mesmo comprimento.

20. 3,925 cm, aproximadamente

21. 125 m

22. $60° \left(\text{ou } \dfrac{\pi}{3} \text{ rad}\right)$ e $300° \left(\text{ou } \dfrac{5\pi}{3} \text{ rad}\right)$

23. 120° **24.** a) $A = \dfrac{15\theta}{2}$ b) 64°

25.

26.

27. 1º quadrante: $\dfrac{\pi}{6}, \dfrac{2\pi}{7}, \dfrac{5\pi}{12}$

2º quadrante: $\dfrac{3\pi}{5}, \dfrac{2\pi}{3}, \dfrac{7\pi}{12}, 2, \dfrac{5\pi}{9}$

3º quadrante: $\dfrac{4\pi}{3}, \dfrac{15\pi}{11}$

4º quadrante: $\dfrac{7\pi}{4}, \dfrac{16\pi}{9}$

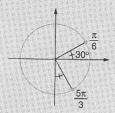
28. $\dfrac{\pi}{4}; \dfrac{7\pi}{6}$

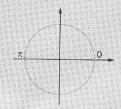
29. a) São diametralmente opostos.
b) São diametralmente opostos.

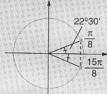
30. a) 2 b) $\sqrt{2}$ c) $\sqrt{2+\sqrt{2}}$ d) 1

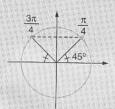
31.

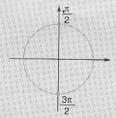
Os pontos são simétricos em relação ao eixo vertical.

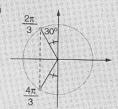
32. a)

Não há simetria.

b)

Os pontos são diametralmente opostos.

c)

Os pontos são simétricos em relação ao eixo horizontal.

d)

Os pontos são simétricos em relação ao eixo vertical.

e)

Os pontos são simétricos em relação ao eixo horizontal e ao centro.

f)

Os pontos são simétricos em relação ao eixo horizontal.

33. Q: $\frac{5\pi}{6}$; Q': $\frac{11\pi}{6}$

Há simetria em relação ao centro.

34. $\frac{\pi}{7}$

35. a) P: $\frac{\pi}{4}$ P': $\frac{3\pi}{4}$ P'': $\frac{5\pi}{4}$ P''': $\frac{7\pi}{4}$

Simetria em relação:
- ao eixo vertical: P e P'; P'' e P'''
- ao eixo horizontal: P e P'''; P' e P''
- ao centro: P e P''; P' e P'''

b) Q: $\frac{\pi}{6}$ Q': $\frac{5\pi}{6}$ Q'': $\frac{7\pi}{6}$ Q''': $\frac{11\pi}{6}$

Simetria em relação:
- ao eixo vertical: Q e Q'; Q'' e Q'''
- ao eixo horizontal: Q e Q'''; Q' e Q''
- ao centro: Q e Q''; Q' e Q'''

TESTES DE VESTIBULARES

1. d
2. d
3. e
4. c
5. b
6. a
7. c
8. c
9. b
10. d
11. b
12. e
13. e
14. c

14 RAZÕES TRIGONOMÉTRICAS NA CIRCUNFERÊNCIA

EXERCÍCIOS

1. a) -1 b) $-\frac{1}{2}$

2. a) $\frac{\sqrt{3}}{2}$ b) $\frac{\sqrt{3}}{2}$ c) $-\frac{1}{2}$ d) $-\frac{\sqrt{3}}{2}$ e) -1 f) $-\frac{\sqrt{3}}{2}$ g) $-\frac{1}{2}$ h) 1

3. a) $\frac{\sqrt{2}}{2}$ b) $\frac{\sqrt{2}}{2}$ c) $-\frac{\sqrt{2}}{2}$ d) $-\frac{\sqrt{2}}{2}$

4. $5 + 2\sqrt{2} + \frac{3\sqrt{3}}{2}$

5. 1

6. $\frac{2\pi}{3}$ — $\frac{4\pi}{3}$; $\frac{5\pi}{3}$ — $60°$; $\frac{5\pi}{4}$ — $\frac{7\pi}{4}$

(coluna esquerda: $\frac{2\pi}{3}$, $\frac{5\pi}{3}$, $\frac{5\pi}{4}$; coluna direita: $\frac{4\pi}{3}$, $\frac{7\pi}{4}$, $60°$)

7. $\text{sen}\,\frac{3\pi}{2} < \text{sen}\,\frac{5\pi}{4} < \text{sen}\,\frac{11\pi}{6} < \text{sen}\,\pi = \text{sen}\,0 < \text{sen}\,\frac{\pi}{2}$

8. a) $-3 \leqslant m \leqslant 1; m \in \mathbb{R}$
b) $-\frac{1}{2} \leqslant m \leqslant \frac{7}{2}; m \in \mathbb{R}$
c) $m \geqslant 1; m \in \mathbb{R}$

9. a) 0,76604 c) −0,64279
b) −0,76604 d) 0,58779

10. a) sen 75° < sen 85° c) sen 250° > sen 260°
b) sen 100° > sen 170° d) sen 300° > sen 290°

11. $-\frac{1}{3} \leqslant m < 0$

12. a) D, sobre $\overline{AB}$, dista a de A; assim, $A\hat{C}D = C\hat{A}D = 36°$, e ACD é isósceles. Nessas condições, $B\hat{C}D$ mede 36° e $B\hat{D}C$ mede 72°, o mesmo ocorrendo com $C\hat{B}D$. Logo, o triângulo BCD também é isósceles.
b) $\triangle ACD$: lei dos senos: $\frac{a}{\text{sen}\,36°} = \frac{b}{\text{sen}\,108°}$
Mas sen 108° = sen 72°;
assim, $a \cdot \text{sen}\,\frac{2\pi}{5} = b \cdot \text{sen}\,\frac{\pi}{5}$.

13. a) $x = \frac{\pi}{6}$ ou $x = \frac{5\pi}{6}$ c) Não há x.
b) $x = 0$ d) $x = \frac{\pi}{4}$ ou $x = \frac{3\pi}{4}$

14.

$\cos\frac{\pi}{6} = \cos\frac{11\pi}{6} = \frac{\sqrt{3}}{2}$

$\cos\frac{5\pi}{6} = \cos\frac{7\pi}{6} = -\frac{\sqrt{3}}{2}$

15.

$\cos\frac{\pi}{5} > 0; \cos\frac{9\pi}{5} > 0$

$\cos\frac{4\pi}{5} < 0; \cos\frac{6\pi}{5} < 0$

16. a) $\frac{\sqrt{6} - \sqrt{2}}{2}$ b) $\sqrt{3}$

17. a) −0,34202 c) 0
b) −1,96962 d) 0,34202

18. a) cos 65° > cos 70° c) cos 50° < cos 340°
b) cos 100° = cos 260° d) cos 91° < cos 89°

19. a) $0 \leqslant m \leqslant 1$ c) $m \geqslant 1$
b) $-4 \leqslant m \leqslant 0$

20. $-1 < m < -\frac{1}{2}, m \in \mathbb{R}$

21. a) $\frac{3}{2} \leqslant p \leqslant \frac{13}{2}, p \in \mathbb{R}$ b) $x = \pi$

22. a) $\frac{1+\sqrt{3}}{2}$ b) $\frac{\sqrt{3}-1}{2}$ c) 0 d) 1

23. a) $y_1 > 0$ c) $y_3 < 0$
b) $y_2 > 0$ d) $y_4 = 0$

24. $x = \pm 1$ 25. $A'B' = \frac{\cos\alpha}{2}$ 26. $\frac{3+\sqrt{3}}{2}$

27. a) $\lambda = 3$ b) maio e novembro 28. $-\frac{4}{5}$

29. $-\frac{5}{13}$ 30. $\frac{24}{25}$ 31. $\frac{\sqrt{15}}{4}$

32. $\text{sen}\,x = \frac{-3\sqrt{10}}{10}$ e $\cos x = \frac{\sqrt{10}}{10}$

33. a) $\frac{\pi}{4}$ e $\frac{5\pi}{4}$ c) $\frac{\pi}{2}$ e $\frac{3\pi}{2}$
b) $\frac{3\pi}{4}$ e $\frac{7\pi}{4}$ d) 0 e π

34. a) F b) V c) V

35. $\cos a = \frac{1}{2}; a = \frac{\pi}{2}$ 36. p

37. Sim, pois sen 65° = cos 25° e cos² 25° + sen² 25° = 1.

38. $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

39. a) positivo b) p

40. 60 41. negativo

42. $\text{tg}\,\frac{\pi}{3} > \text{tg}\,\frac{\pi}{4} > \text{tg}\,\frac{\pi}{6} > \text{tg}\,0 > \text{tg}\,\frac{3\pi}{4} > \text{tg}\,\frac{2\pi}{3}$

43. −2

44.

O quadrilátero é um quadrado de lado unitário:

$\text{tg}\,\frac{\pi}{4} = 1$

$\text{tg}\,\frac{5\pi}{4} = 1$

45. Como $\frac{7\pi}{4} - \frac{3\pi}{4} = \frac{4\pi}{4} = \pi$, as extremidades dos arcos são pontos diametralmente opostos. Assim, os prolongamentos dos raios coincidem, atingindo o eixo das tangentes no mesmo ponto.

46. a) $\sqrt{3}$ b) $-\sqrt{3}$ c) $\frac{-\sqrt{3}}{3}$ d) $\frac{\sqrt{3}}{3}$

47. a) $-\sqrt{3}$ b) Não existe. c) 1 d) 0

48. 0 49. $\cos x = \frac{-2\sqrt{2}}{3}$ e $\text{tg}\,x = \frac{\sqrt{2}}{4}$

50. a) $x = \frac{\pi}{6}$ ou $x = \frac{7\pi}{6}$

b) $x = \frac{\pi}{3}$ ou $x = \frac{4\pi}{3}$

c) $x = 0$ ou $x = \pi$

d) $x = \frac{\pi}{4}$ ou $x = \frac{3\pi}{4}$ ou $x = \frac{5\pi}{4}$ ou $x = \frac{7\pi}{4}$

51. $\text{sen}\, x = \frac{\sqrt{3}}{3}$ e $\cos x = \frac{-\sqrt{6}}{3}$

52. $4 - 2\sqrt{3}$

53. a) $x = \frac{\pi}{2}$ e $x = \frac{3\pi}{2}$ c) $x = \frac{\pi}{2}$ e $x = \frac{3\pi}{2}$

b) $x = 0$ e $x = \pi$ d) $x = 0$ e $x = \pi$

54. a) Crescente nos quatro quadrantes.
b) Decrescente nos quatro quadrantes.
c) Crescente no 1º e no 2º quadrantes; decrescente no 3º e no 4º quadrantes.
d) Decrescente no 1º e no 4º quadrantes; crescente no 2º e no 3º quadrantes.

55. $x \in]0, 2\pi[\mid x \neq \frac{\pi}{2},\ x \neq \pi$ e $x \neq \frac{3\pi}{2}$

56. a) 0 d) Não existe. g) -1

b) $\frac{-\sqrt{3}}{3}$ e) -2 h) $\frac{2\sqrt{3}}{3}$

c) Não existe. f) -1 i) Não existe.

57. 1

58. a) 0 e π c) $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}$ e $\frac{7\pi}{4}$

b) $\frac{\pi}{2}$ e $\frac{3\pi}{2}$

59. negativo **60.** sim; não

61. a) $\text{sen}\, 65° < \text{sen}\, 70°$ d) $\text{cotg}\, 65° > \text{cotg}\, 70°$
b) $\cos 65° > \cos 70°$ e) $\sec 65° < \sec 70°$
c) $\text{tg}\, 65° < \text{tg}\, 70°$ f) $\text{cossec}\, 65° > \text{cossec}\, 70°$

62. a) $x \neq 0, x \neq \frac{\pi}{2}, x \neq \pi$ e $x \neq \frac{3\pi}{2}$

b) 1

TESTES DE VESTIBULARES

1. b **2.** c **3.** e **4.** d **5.** a

6. b **7.** d **8.** e **9.** c **10.** a) V b) V c) V d) V e) V

11. a **12.** d **13.** d **14.** b **15.** b **16.** d **17.** e

15 RELAÇÕES ENTRE AS RAZÕES TRIGONOMÉTRICAS

EXERCÍCIOS

1. $\frac{\sqrt{33}}{7}$ **2.** $-\frac{\sqrt{91}}{10}$ **3.** $\pm\frac{\sqrt{15}}{4}$

4. sim; $\frac{\sqrt{5}}{3}$ **5.** $\text{sen}\, \widehat{AMP}$; $-\frac{\sqrt{3}}{2}$

6. $\frac{2\sqrt{5}}{15}$ **7.** ± 1 **8.** $\frac{5}{12}$

9. $\sec \beta = \frac{5}{3}$ e $\text{cossec}\, \beta = \frac{5}{4}$

10. 9 **11.** $-\frac{\sqrt{3}}{3}$

12. $\cos x = -\frac{\sqrt{14}}{4}$ $\text{cotg}\, x = -\sqrt{7}$

$\text{tg}\, x = -\frac{\sqrt{7}}{7}$ $\text{cossec}\, x = 2\sqrt{2}$

$\sec x = -\frac{2\sqrt{14}}{7}$

13. $\sec x < \text{cotg}\, x < \text{tg}\, x < \cos x < \text{sen}\, x < \text{cossec}\, x$

14. $m = 0$ ou $m = \frac{4}{5}$ **15.** $ab = 1$

16. a) $\text{tg}\, \alpha = 3$, $\text{cotg}\, \alpha = \frac{1}{3}$ e $\cos \alpha = \pm\frac{\sqrt{10}}{10}$

b) 1º ou 3º

17. $\text{cotg}\, x = \frac{3}{4}$; $\sec x = \frac{5}{3}$

18. $\text{cossec}\, x = -\frac{61}{11}$; $\text{tg}\, x = \frac{11}{60}$

19. $\text{tg}\, x = \sqrt{3}$; $x = \frac{\pi}{3}$ **20.** $\text{tg}\, x = -\frac{2\sqrt{10}}{3}$; $m = -\frac{\sqrt{10}}{10}$

21. $\frac{1}{3}$ **22.** $\text{sen}\, \theta = -\frac{2\sqrt{5}}{5}$; $\cos \theta = -\frac{\sqrt{5}}{5}$

23. 1 **24.** $\cos x = -\frac{2\sqrt{13}}{13}$

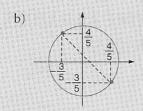
25. $\text{tg}\, x = -\frac{5}{12}$ **26.** $ab = \pm 1$

27. $3\sqrt{11}$ **28.** $\frac{1}{2}$

29. $x = \text{cotg}\, x \pm \text{cossec}\, \alpha$ **30.** $x = \pm 1 + \sec \alpha$

31. a) $\text{sen}\, \alpha = \frac{-3}{5}$ e $\cos \alpha = \frac{4}{5}$ ou

$\text{sen}\, \alpha = \frac{4}{5}$ e $\cos \alpha = \frac{-3}{5}$

b)

32. $\left(\dfrac{30\sqrt{61}}{61}, \dfrac{15\sqrt{61}}{61}, 0\right)$

33. $-\dfrac{1}{9}$ **36.** $\dfrac{7}{10}$

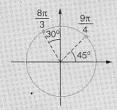
37. a) $\left(\dfrac{20\sqrt{3}}{3} + 10\right)$ cm b) $\dfrac{k}{2}(3 - k^2)$

TESTES DE VESTIBULARES

1. c	**5.** d	**9.** a	**13.** a
2. d	**6.** a	**10.** d	**14.** b
3. d	**7.** c	**11.** a	**15.** c
4. e	**8.** e	**12.** c	**16.** c

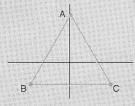
16 FUNÇÕES CIRCULARES

EXERCÍCIOS

1.

2. a) $(2k + 1)\pi, k \in \mathbb{Z}$ c) $2k\pi, k \in \mathbb{Z}$
b) $\dfrac{3\pi}{2} + 2k\pi, k \in \mathbb{Z}$ d) $\dfrac{\pi}{4} + 2k\pi, k \in \mathbb{Z}$

3. $\dfrac{\pi}{6} + 2k\pi, k \in \mathbb{Z}$

4. a) 90° b) 60° c) 135° d) 15°

6.

A: $\dfrac{\pi}{2} + 2k\pi, k \in \mathbb{Z}$

B: $\dfrac{7\pi}{6} + 2k\pi, k \in \mathbb{Z}$

C: $\dfrac{11\pi}{6} + 2k\pi, k \in \mathbb{Z}$

7. a) positivo c) positivo
b) negativo d) nulo

8. a) 0 b) −1 c) $\sqrt{2} - 1$ d) $\dfrac{\sqrt{3}}{2}$

9. a) $\dfrac{\sqrt{3}}{2}$ b) $\dfrac{1}{2}$ c) $\dfrac{1 + \sqrt{3}}{2}$ d) 1

10. a) $x = k\pi, k \in \mathbb{Z}$
b) $x = \dfrac{\pi}{2} + 2k\pi, k \in \mathbb{Z}$
c) $x = \dfrac{3\pi}{2} + 2k\pi, k \in \mathbb{Z}$
d) $x = \dfrac{\pi}{2} + k\pi, k \in \mathbb{Z}$

11. a) $A = 1$ b) $B = \dfrac{-2 - 3\sqrt{2}}{2}$

12. a) π c) 4π e) 2π
b) 2π d) π f) 4π

13. a) $D = \mathbb{R}$; $Im = [2, 4]$
b) $D = \mathbb{R}$; $Im = [-1, 1]$
c) $D = \mathbb{R}$; $Im\ [-6, -2]$
d) $D = \mathbb{R}$; $Im \left[-\dfrac{2}{3}, \dfrac{2}{3}\right]$

14. a) $D = \{x \in \mathbb{R} \mid x \neq k\pi, k \in \mathbb{Z}\}$
b) $D = \left\{x \in \mathbb{R} \mid x \neq \dfrac{\pi}{2} + k\pi, k \in \mathbb{Z}\right\}$

15. $m = \pm 10$

16. a) 6,5 m b) altura máxima: 21,5 m
altura mínima: 1,5 m
período: 24 s

17. a) março e novembro b) janeiro

18. a) maior preço: R$ 3,50 b) 131 e 251
menor preço: R$ 1,90

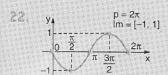
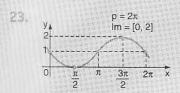
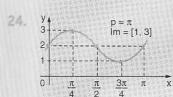
19. $p = 2\pi$
$Im = [-3, 3]$

20. $p = \dfrac{2\pi}{3}$
$Im = [-1, 1]$

21. $p = 2\pi$
$Im = [2, 4]$

22.

23.

24.

25. a) $x = 2k\pi, k \in \mathbb{Z}$ c) $x = k\pi, k \in \mathbb{Z}$

b) $x = (2k + 1)\pi, k \in \mathbb{Z}$ d) $x = \frac{\pi}{2} + k\pi, k \in \mathbb{Z}$

26. a) -1 c) $2\sqrt{2}$

b) $\frac{1 + \sqrt{3}}{2}$ d) $-\frac{1}{2}$

27. a) $A = 2\sqrt{2} + \sqrt{6} - \sqrt{3} - 2$ b) $B = -\frac{\sqrt{2}}{4}$

28. a) $-1 \leq m \leq 3, m \in \mathbb{R}$

b) $-1 \leq m \leq 3, m \in \mathbb{R}$

29. a) $\frac{2\pi}{5}$ c) 2π

b) $\frac{2\pi}{5}$ d) Não existe.

30. a) V b) V

31. 492; 15 **32.** 6

33. a) $D = \mathbb{R}; Im = [0, 2]$ c) $D = \mathbb{R}; Im = [-100, 100]$

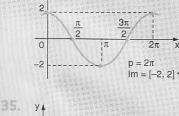
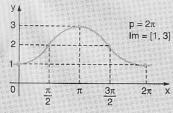
b) $D = \mathbb{R}; Im = [0, 2]$ d) $D = \mathbb{R}; Im = \left[-\frac{1}{3}, \frac{1}{3}\right]$

34.

35.

36. p = π
Im = [–2, 0]

37. p = π
Im = [0, 1]

38. $p = \frac{2\pi}{3}$
Im = [–1, 3]

39. $f(x) = 1 + \cos\left(2x - \frac{\pi}{4}\right)$

40. a) $D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{2} + k\pi, k \in \mathbb{Z}\right\}$

b) $D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{2} + k\pi, k \in \mathbb{Z}\right\}$

c) $D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{4} + k\frac{\pi}{2}, k \in \mathbb{Z}\right\}$

d) $D = \{x \in \mathbb{R} \mid x \neq k\pi, k \in \mathbb{Z}\}$

41. $\mathbb{R}$ **42.** a) $m \neq 2, m \in \mathbb{R}$

b) $D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{4} + k\pi, k \in \mathbb{Z}\right\}$

43.

$D = \{x \in \mathbb{R} \mid x \neq (2k + 1)\pi, k \in \mathbb{Z}\}$

$p = 2\pi$

44.

$D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{12} + k\frac{\pi}{2}, k \in \mathbb{Z}\right\}$

$p = \frac{\pi}{2}$

45.

$D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{3} + k\frac{\pi}{2}, k \in \mathbb{Z}\right\}$

$p = \frac{\pi}{2}$

46. a) $x = \frac{\pi}{2} + k\pi, k \in \mathbb{Z}$
b) Não há.
c) Não há.
d) $x = \frac{\pi}{4} + k\pi, k \in \mathbb{Z}$
e) $x = 2k\pi, k \in \mathbb{Z}$
f) $x = \frac{\pi}{2} + 2k\pi, k \in \mathbb{Z}$

47. a) $D = \{x \in \mathbb{R} \mid x \neq k\pi, k \in \mathbb{Z}\}$
b) $D = \{x \in \mathbb{R} \mid x \neq k\pi, k \in \mathbb{Z}\}$
c) $D = \left\{x \in \mathbb{R} \mid x \neq \frac{\pi}{2} + k\pi, k \in \mathbb{Z}\right\}$

48. $x = 2k\pi, k \in \mathbb{Z}$; 2

49. $D = \{x \in \mathbb{R} \mid x \neq k\pi, k \in \mathbb{Z}\}$

50. P_1: A, B, F, G
P_2: C, E

51. D_1: A, B
D_2: C, F
D_3: E, G

52. I_1: C, E
I_2: A, B
I_3: F, G

TESTES DE VESTIBULARES

1. e
2. b
3. c
4. a
5. a
6. a
7. a
8. d
9. b
10. e
11. a) F b) F c) V d) F e) V
12. c
13. d
14. d
15. a
16. b
17. d
18. a) V b) F c) V d) V e) V
19. b
20. e
21. b

17 TRANSFORMAÇÕES

EXERCÍCIOS

1. a) $\frac{\sqrt{6} - \sqrt{2}}{4}$
b) $-\frac{\sqrt{6} + \sqrt{2}}{4}$
c) $\sqrt{6} - \sqrt{2}$
d) $\sqrt{6} - \sqrt{2}$

2. $\text{sen } 105° = \frac{\sqrt{6} + \sqrt{2}}{4}$; $\cos 105° = \frac{\sqrt{2} - \sqrt{6}}{4}$; $\text{tg } 105° = -(2 + \sqrt{3})$; $\text{cossec } 105° = \sqrt{6} - \sqrt{2}$; $\sec 105° = -\sqrt{2} - \sqrt{6}$; $\text{cotg } 105° = \sqrt{3} - 2$

3. $\sec \frac{13\pi}{12} = \sqrt{2} - \sqrt{6}$; $\text{cossec } \frac{13\pi}{12} = -\sqrt{2} - \sqrt{6}$

4. $\frac{1}{4}$

5. a) $A = 1$
b) $B = 0$
c) sen 50°
d) cos 50°

6. a) $\frac{1}{2}(\text{sen } x + \sqrt{3} \cos x)$
b) $\frac{1}{2}(\cos x + \sqrt{3} \text{ sen } x)$
c) $\frac{\sqrt{2}}{2}(\text{sen } x + \cos x)$
d) $\frac{\sqrt{2}}{2}(\text{sen } x + \cos x)$

7. $\frac{\sqrt{3}}{2}$

8. a) $\frac{1 - \sqrt{3}}{2}(\text{sen } x + \cos x)$
b) sen x − cos x

10. a) $2 - \sqrt{3}$

11. a) $-(2 + \sqrt{3})$
b) $\sqrt{3} - 2$
c) $2 + \sqrt{3}$
d) $\sqrt{3} - 2$

12. $\sqrt{3} - 2$

13. a) a
b) $1 - 2a^2$
c) $\frac{(1 - 2a^2)\sqrt{1 - a^2}}{2a(1 - a^2)}$

14. a) 3
b) $-\frac{9}{13}$
c) $\frac{13\sqrt{10}}{50}$

15. a) $-\frac{23}{25}$
b) 1
c) $\frac{23\sqrt{6}}{24}$
d) $\frac{4\sqrt{6}}{25}$

17. 3

18. $a\sqrt{2}$

19. $-\frac{4\sqrt{5}}{9}$

20. $\frac{16\sqrt{17}}{81}$

21. $\frac{9\sqrt{19}}{50}$; 2º quadrante

22. $\frac{24}{25}$

23. a) $\frac{-7}{9}$
b) $\frac{7}{9}$

24. $\frac{-\sqrt{2}}{2}$

25. a) cos 140°
b) cos 4x

26. $\frac{\sqrt{2}}{2}$

27. a) $1 + \frac{\sqrt{2}}{2}$
b) $\frac{4 + \sqrt{2} - \sqrt{6}}{4}$

29. $\frac{120}{169}$

30. $-1 \leqslant k \leqslant \frac{1}{2}$

31. a) $\frac{3}{4}$
b) $-\frac{\sqrt{7}}{4}$
c) $\frac{-3\sqrt{7}}{7}$

32. sec x

33. a) $\frac{1\,320}{3\,479}$ b) $\frac{3\,479}{3\,721}$

34. $\frac{\pi}{6}$ rad

35. 93,75 m

36. $-\frac{\sqrt{2}}{2}$

37. a) $\sqrt{3}\cos 20°$ b) $\cos 20°$ c) $\cos 20°$ d) $\sqrt{3}\cos 20°$

38. a) $2 \sec 40°$ b) $2 \text{ tg } 40°$

39. a) $4 \text{ sen } x \cos^2 x$ b) $2 \cos x \cos 2x$

40. a) $\left(\cos\frac{x}{2} - \text{sen}\frac{x}{2}\right)^2$ b) $\left(\cos\frac{x}{2} + \text{sen}\frac{x}{2}\right)^2$

41. a) $\cos 20°$ b) $\sqrt{3}\cos 20°$ c) $\frac{\sqrt{3}}{2} \sec 10° \sec 50°$

42. a) $2 \text{ sen } 2x \cos 3x$ b) $4 \text{ sen } 2x \cos 3x \cos 4x$ c) $2 \cos x \cos 4x$

43. $-\cos 2x$

44. $\frac{-\sqrt{2}-2}{4}$

45. $-(\cos 10° + \sqrt{3} \text{ sen } 20°)$

46. $E = -\text{cotg } 10°$

47. a) $\cos^2 x$ b) $-\text{tg}^2 x$

48. $-\text{tg } 3x$

49. $x = 5° + k \cdot 360°$

50. $E = -\cos 4x$

TESTES DE VESTIBULARES

1. c
2. a
3. e
4. d
5. d
6. b
7. e
8. e
9. b
10. b
11. c
12. d
13. d
14. e
15. b
16. a) V b) F c) V d) F e) V
17. c
18. d
19. d
20. c
21. c
22. d
23. a
24. a
25. d

18 EQUAÇÕES E INEQUAÇÕES TRIGONOMÉTRICAS

EXERCÍCIOS

1. a) $\left\{\frac{\pi}{7}, \frac{6\pi}{7}\right\}$ b) $\left\{\frac{\pi}{3}, \frac{2\pi}{3}\right\}$ c) $\left\{\frac{3\pi}{2}\right\}$ d) $\left\{\frac{4\pi}{3}, \frac{5\pi}{3}\right\}$ e) $\left\{\frac{\pi}{4}, \frac{3\pi}{4}\right\}$

2. a) $\left\{\frac{\pi}{5}, \frac{9\pi}{5}\right\}$ b) $\left\{\frac{\pi}{4}, \frac{7\pi}{4}\right\}$ c) $\left\{\frac{\pi}{2}, \frac{3\pi}{2}\right\}$ d) $\{\pi\}$ e) $\left\{\frac{2\pi}{3}, \frac{4\pi}{3}\right\}$

3. a) $\left\{\frac{\pi}{2}, \frac{3\pi}{2}\right\}$ b) $\left\{\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\right\}$ c) $S = \varnothing$ d) $\{0, \pi\}$ e) $\left\{\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\right\}$

4. a) $\frac{3\pi}{10}$ e $\frac{7\pi}{10}$ b) $\frac{2\pi}{5}$ e $\frac{8\pi}{5}$ c) $\frac{\pi}{6}, \frac{\pi}{2}$ e $\frac{5\pi}{6}$ d) $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}$ e $\frac{11\pi}{6}$ e) Não há.

5. a) $\left\{\frac{\pi}{3}, \frac{4\pi}{3}\right\}$ b) $\left\{\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\right\}$ c) $\left\{\frac{\pi}{6}, \frac{7\pi}{6}\right\}$ d) $\{0, \pi, 2\pi\}$ e) $\left\{\frac{2\pi}{3}, \frac{5\pi}{3}\right\}$

6. Os valores de θ são $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}$ e $\frac{7\pi}{4}$.

7. a) $\left\{\frac{3\pi}{4}, \frac{7\pi}{4}\right\}$ b) $\left\{0, \frac{\pi}{4}, \pi, \frac{7\pi}{4}\right\}$

8. a) $\left\{0, \frac{\pi}{6}, \frac{5\pi}{6}, \pi, \frac{7\pi}{6}, \frac{11\pi}{6}, 2\pi\right\}$ b) $\{0, \pi, 2\pi\}$ c) $\{0, \pi, 2\pi\}$

9. a) $\{0, \pi, 2\pi\}$ b) $\left\{\frac{3\pi}{2}\right\}$ c) $\{0, 2\pi\}$ d) $\left\{\frac{\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6}\right\}$

10. a) $\left\{\frac{\pi}{3}, \frac{5\pi}{3}\right\}$ b) $\left\{\frac{4\pi}{3}, \frac{5\pi}{3}\right\}$ c) $\left\{\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}\right\}$ d) $S = \varnothing$

11. 2

12. a) V b) V c) V

13. a) $\left\{\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}\right\}$ b) $\{0, \pi\}$ c) $\left\{\frac{3\pi}{4}, \frac{7\pi}{4}\right\}$ d) $\left\{\frac{\pi}{4}, \frac{5\pi}{4}\right\}$

14. a) $\left\{\frac{\pi}{6}, \frac{\pi}{3}, \frac{7\pi}{6}, \frac{4\pi}{3}\right\}$ b) $\left\{\frac{\pi}{12}, \frac{11\pi}{12}, \frac{13\pi}{12}, \frac{23\pi}{12}\right\}$ c) $\left\{\frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}\right\}$ d) $\left\{\frac{\pi}{6}, \frac{2\pi}{3}, \frac{7\pi}{6}, \frac{5\pi}{3}\right\}$

15. $\frac{\pi}{6}, \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{5\pi}{4}, \frac{7\pi}{4}$ e $\frac{11\pi}{6}$

16. a) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{2} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{7} + 2k\pi \text{ ou } x = \frac{6\pi}{7} + 2k\pi, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid x = \frac{4\pi}{3} + 2k\pi \text{ ou } x = \frac{5\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

d) $\left\{x \in \mathbb{R} \mid x = \frac{5\pi}{4} + 2k\pi \text{ ou } x = \frac{7\pi}{4} + 2k\pi, k \in \mathbb{Z}\right\}$

17. a) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{4} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

c) $\{x \in \mathbb{R} \mid x = 2k\pi, k \in \mathbb{Z}\}$

d) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{6} + \frac{k\pi}{3}, k \in \mathbb{Z}\right\}$

18. a) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{6} + k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{4} + k\pi, k \in \mathbb{Z}\right\}$

c) $\{x \in \mathbb{R} \mid x = k\pi, k \in \mathbb{Z}\}$

d) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{8}, \frac{k\pi}{2}, k \in \mathbb{Z}\right\}$

19. a) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{2} + k\pi, k \in \mathbb{Z}\right\}$

b) $\{x \in \mathbb{R} \mid x = k\pi, k \in \mathbb{Z}\}$

c) $S = \varnothing$

d) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{4} + \frac{k\pi}{2}, k \in \mathbb{Z}\right\}$

20. 9

21. $x = 0$ ou $x = \pm\pi$ ou $x = \pm\frac{2\pi}{3}$

22. a) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = \frac{4\pi}{3} + 2k\pi \text{ ou } x = \frac{5\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

c) $S = \varnothing$

23. a) 2 b) $\pm\frac{\pi}{9}$

24. a) $x = \frac{\pi}{6} + \frac{2k\pi}{3}, k \in \mathbb{Z}$

b) $x = \frac{\pi}{6} + 2k\pi$ ou $x = \frac{\pi}{2} + k\pi$ ou $x = \frac{5\pi}{6} + 2k\pi, k \in \mathbb{Z}$

c) $x = \pm\frac{2\pi}{3} + 2k\pi$ ou $x = k\pi, k \in \mathbb{Z}$

d) $x = \frac{2k\pi}{3}, k \in \mathbb{Z}$

25. a) $S = \varnothing$ b) $S = \varnothing$

26. $x = \frac{\pi}{6}$

27. $p = 2$

28. a) $x = 45° + k \cdot 360°$ ou $x = 135° + k \cdot 360°, k \in \mathbb{Z}$ e $x \in \mathbb{R}$

b) $\left\{x \in \mathbb{R} \mid x = k\pi \text{ ou } x = \frac{\pi}{4} + \frac{k\pi}{2}, k \in \mathbb{Z}\right\}$

c) $\left\{\theta \in \mathbb{R} \mid \theta = \frac{2k\pi}{3}, k \in \mathbb{Z}\right\}$

29. a) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{3} + k\pi, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{4} + k\pi, k \in \mathbb{Z}\right\}$

d) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{2} + \frac{2k\pi}{3}, k \in \mathbb{Z}\right\}$

30. a) $\left\{x \in \mathbb{R} \mid x = \frac{k\pi}{2}, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = k\pi \text{ ou } x = \frac{\pi}{4} + \frac{k\pi}{2}, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid x = k\pi \text{ ou } x = \frac{\pi}{6} + k\pi \text{ ou } x = \frac{5\pi}{6} + k\pi, k \in \mathbb{Z}\right\}$

d) $\left\{x \in \mathbb{R} \mid x = k\pi \text{ ou } x = \pm\frac{2\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

31. a) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{4} + \frac{k\pi}{2} \text{ ou } x = \pm\frac{\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid x = \frac{k\pi}{4}, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid x = \frac{\pi}{4} + \frac{k\pi}{2} \text{ ou } x = \pm\frac{\pi}{3} + k\pi, k \in \mathbb{Z}\right\}$

d) $\left\{x \in \mathbb{R} \mid x = \pm\frac{\pi}{12} + \frac{k\pi}{2}, k \in \mathbb{R}\right\}$

32. a) $x = \frac{\pi}{4} + 2k\pi, k \in \mathbb{Z}$

b) $x = \frac{\pi}{2} + 2k\pi$ e $y = 2k\pi, k \in \mathbb{Z}$

33. a) $\{x \in \mathbb{R} \mid x = 2k\pi, k \in \mathbb{Z}\}$

b) $\left\{x \in \mathbb{R} \mid x = \pm\frac{2\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

34. a) $k = 2, m = 3$ e $n = \pm 2$ ou $k = -2, m = -3$ e $n = \pm 2$

b) $0, \frac{\pi}{4}, \frac{\pi}{3}, \frac{2\pi}{3}, \frac{3\pi}{4}$ e π

35. a) $f(2) = 0{,}35$ °C e $f(9) = -0{,}7$ °C

b) 0 h, 8 h, 16 h e 24 h

45. a) $\left\{x \in \mathbb{R} \mid \frac{\pi}{4} \leqslant x \leqslant \frac{3\pi}{4}\right\}$

b) $\left\{x \in \mathbb{R} \mid 0 \leqslant x \leqslant \frac{\pi}{4} \text{ ou } \frac{3\pi}{4} \leqslant x < 2\pi\right\}$

c) $\left\{x \in \mathbb{R} \mid 0 \leqslant x \leqslant \frac{5\pi}{4} \text{ ou } \frac{7\pi}{4} \leqslant x < 2\pi\right\}$

d) $\left\{x \in \mathbb{R} \mid \frac{5\pi}{4} \leqslant x \leqslant \frac{7\pi}{4}\right\}$

46. a) $\left\{x \in \mathbb{R} \mid \frac{\pi}{3} + 2k\pi < x < \frac{2\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\{x \in \mathbb{R} \mid (2k+1)\pi < x < 2(k+1)\pi, k \in \mathbb{Z}\}$

c) $\{x \in \mathbb{R} \mid 2k\pi \leqslant x \leqslant (2k+1)\pi, k \in \mathbb{Z}\}$

d) $\left\{x \in \mathbb{R} \mid \frac{7\pi}{6} + 2k\pi \leqslant x \leqslant \frac{11\pi}{6} + 2k\pi, k \in \mathbb{Z}\right\}$

47. $\left\{x \in \mathbb{R} \mid \frac{\pi}{6} \leqslant x \leqslant \frac{\pi}{3} \text{ ou } \frac{2\pi}{3} \leqslant x \leqslant \frac{5\pi}{6}\right\}$

48. $\left\{x \in \mathbb{R} \mid \frac{\pi}{4} + 2k\pi < x < \frac{3\pi}{4} + 2k\pi \text{ ou } \frac{5\pi}{4} + 2k\pi < x < \frac{7\pi}{4} + 2k\pi, k \in \mathbb{Z}\right\}$

49. a) $D = \{x \in \mathbb{R} \mid (2k+1)\pi \leqslant x \leqslant 2(k+1)\pi, k \in \mathbb{Z}\}$

b) $D = \mathbb{R}$

c) $D = \mathbb{R}$

d) $D = \left\{x \in \mathbb{R} \mid \frac{7\pi}{6} + 2k\pi \leqslant x \leqslant \frac{11\pi}{6} + 2k\pi \text{ ou } x = \frac{\pi}{2} + 2k\pi, k \in \mathbb{Z}\right\}$

e) $D = \mathbb{R}$

50. a) $\left\{x \in \mathbb{R} \mid \frac{\pi}{4} < x < \frac{7\pi}{4}\right\}$

b) $\left\{x \in \mathbb{R} \mid \frac{3\pi}{4} \leqslant x \leqslant \frac{5\pi}{4}\right\}$

c) $\left\{x \in \mathbb{R} \mid \frac{\pi}{3} < x < \frac{5\pi}{3}\right\}$

d) $\left\{x \in \mathbb{R} \mid 0 \leqslant x \leqslant \frac{\pi}{6} \text{ ou } \frac{11\pi}{6} \leqslant x < 2\pi\right\}$

51. a) $\left\{x \in \mathbb{R} \mid 2k\pi \leqslant x \leqslant \frac{\pi}{4} + 2k\pi \text{ ou } \frac{7\pi}{4} + 2k\pi \leqslant x < (2k+1)\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid \frac{2\pi}{3} + 2k\pi \leqslant x \leqslant \frac{4\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid \frac{\pi}{3} + 2k\pi < x < \frac{5\pi}{3} + 2k\pi, x \neq (2k+1)\pi, k \in \mathbb{Z}\right\}$

d) $\left\{x \in \mathbb{R} \mid \frac{\pi}{3} + 2k\pi \leqslant x \leqslant \frac{2\pi}{3} + 2k\pi \text{ ou } \frac{4\pi}{3} + 2k\pi \leqslant x \leqslant \frac{5\pi}{3} + 2k\pi, k \in \mathbb{Z}\right\}$

52. a) $D = \left\{x \in \mathbb{R} \mid \frac{\pi}{2} + 2k\pi \leqslant x \leqslant \frac{3\pi}{2} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $D = \mathbb{R}$

53. a) $\left\{x \in \mathbb{R} \mid 0 < x < \frac{5\pi}{6} \text{ ou } \frac{11\pi}{6} < x < 2\pi\right\}$

b) $\left\{x \in \mathbb{R} \mid \frac{3\pi}{2} < x < 2\pi\right\}$

c) $\left\{x \in \mathbb{R} \mid \frac{\pi}{6} + 2k\pi \leqslant x \leqslant \frac{\pi}{3} + 2k\pi \text{ ou } \frac{5\pi}{3} + 2k\pi \leqslant x \leqslant \frac{11\pi}{6} + 2k\pi, k \in \mathbb{Z}\right\}$

54. a) $\left]\frac{\pi}{4}, \frac{5\pi}{4}\right[$ b) $\left[0, \frac{\pi}{4}\right[\cup \left]\frac{5\pi}{4}, 2\pi\right]$

55. $\left\{x \in \mathbb{R} \mid \frac{\pi}{6} < x \leqslant \frac{\pi}{2}\right\}$

56. a) $\left\{x \in \mathbb{R} \mid \frac{\pi}{6} < x < \frac{\pi}{2} \text{ ou } \frac{7\pi}{6} < x < \frac{3\pi}{2}\right\}$

b) $\left\{x \in \mathbb{R} \mid \frac{\pi}{3} < x < \frac{\pi}{2} \text{ ou } \frac{4\pi}{3} < x < \frac{3\pi}{2}\right\}$

c) $\left\{x \in \mathbb{R} \mid 0 \leqslant x < \frac{\pi}{2} \text{ ou } \frac{3\pi}{4} < x < \frac{3\pi}{2} \text{ ou } \frac{7\pi}{4} < x \leqslant 2\pi\right\}$

d) $\left\{x \in \mathbb{R} \mid 0 < x < \frac{\pi}{2} \text{ ou } \pi < x < \frac{3\pi}{2}\right\}$

57. a) $0 < x < \frac{\pi}{2}$ ou $\pi < x < \frac{3\pi}{2}$

b) $\left\{\frac{\pi}{2}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{3\pi}{2}\right\}$

58. a) $\left\{x \in \mathbb{R} \mid k\pi \leqslant x < \frac{\pi}{4} + k\pi \text{ ou } \frac{\pi}{2} + k\pi < x < (k+1)\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid \frac{\pi}{2} + k\pi < x \leqslant \frac{3\pi}{4} + k\pi, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid k\pi \leqslant x < \frac{\pi}{3} + k\pi \text{ ou } \frac{\pi}{2} + k\pi < x < (k+1)\pi, k \in \mathbb{Z}\right\}$

d) $\left\{x \in \mathbb{R} \mid k\pi < x < \frac{\pi}{2} + k\pi, k \in \mathbb{Z}\right\}$

59. a) $\left\{x \in \mathbb{R} \mid 0 \leqslant x < \frac{\pi}{4} \text{ ou } \frac{3\pi}{4} < x < \frac{5\pi}{4} \text{ ou } \frac{7\pi}{4} < x \leqslant 2\pi\right\}$

b) $\left\{x \in \mathbb{R} \mid \frac{3\pi}{4} \leqslant x \leqslant \pi \text{ ou } \frac{7\pi}{4} \leqslant x \leqslant 2\pi\right\}$

c) $\left\{x \in \mathbb{R} \mid \frac{\pi}{4} < x < \frac{\pi}{3} \text{ ou } \frac{5\pi}{4} < x < \frac{4\pi}{3}\right\}$

60. a) $\left\{x \in \mathbb{R} \mid \frac{\pi}{6} + 2k\pi < x < \frac{2\pi}{3} + 2k\pi \text{ ou } \frac{4\pi}{3} + 2k\pi < x < \frac{11\pi}{6} + 2k\pi, k \in \mathbb{Z}\right\}$

b) $\left\{x \in \mathbb{R} \mid 2k\pi \leqslant x < \frac{\pi}{6} + 2k\pi \text{ ou } \frac{5\pi}{6} + 2k\pi < x \leqslant \frac{7\pi}{6} + 2k\pi \text{ ou } \frac{11\pi}{6} + 2k\pi \leqslant x < (2k+1)\pi, k \in \mathbb{Z}\right\}$

c) $\left\{x \in \mathbb{R} \mid 2k\pi \leqslant x < \frac{\pi}{3} + 2k\pi \text{ ou } \frac{3\pi}{4} + 2k\pi \leqslant x < \frac{4\pi}{3} + 2k\pi \text{ ou } \frac{7\pi}{4} + 2k\pi \leqslant x < 2(k+1)\pi, k \in \mathbb{Z}\right\}$

TESTES DE VESTIBULARES

1. e	7. c	13. c	19. d
2. d	8. a	14. a	20. a
3. d	9. b	15. e	21. c
4. b	10. d	16. c	22. b
5. d	11. a	17. d	23. a
6. c	12. a	18. e	

19 MATRIZES

EXERCÍCIOS

1. a) 3×2 c) 2×2 e) 3×1
   b) 1×4 d) 3×3 f) 3×4

2. $A = \begin{bmatrix} 1 & -1 & -3 & -5 \\ 4 & 2 & 0 & -2 \\ 7 & 5 & 3 & 1 \\ 10 & 8 & 6 & 4 \end{bmatrix}$

3. $B = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 4 & 8 \\ 3 & 9 & 27 \end{bmatrix}$ diagonal principal: 1, 4, 27
   diagonal secundária: 3, 4, 1

4. $C = \begin{bmatrix} 2 \\ 5 \\ 10 \\ 17 \end{bmatrix}$ é matriz coluna.
   $D = (0 \quad -1 \quad -2)$ é matriz linha.

5. $A = \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

6. $A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 4 & 0 & 0 \\ 0 & 0 & 6 & 0 \\ 0 & 0 & 0 & 8 \end{bmatrix}$ diagonal principal: 2, 4, 6, 8
   diagonal secundária: 0, 0, 0, 0

7. 3

8. a) 2º instante e 4º dia b) 37,3 °C

9. $a = 2; b = 1; c = 6; d = 4$

10. $x = 4; y = 3; z = 2$

11. $p = 3; q = -4$

12. Não existe.

13. $m = -3$

14. $m = 0; n = 2; p = -2$

15. $x = 1; y = -1$

16. a) $\begin{pmatrix} 11 & 5 \\ 14 & 12 \end{pmatrix}$ c) $(-5 \quad -1 \quad -8 \quad -3)$
    b) $\begin{bmatrix} 11 & 16 \\ 2 & 7 \\ 1 & 5 \end{bmatrix}$ d) $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 0 & 2 \end{bmatrix}$

17. $C = \begin{bmatrix} 1 & 1 \\ 3 & 3 \\ 5 & 5 \end{bmatrix}$, $D = \begin{bmatrix} -1 & -3 \\ -1 & -3 \\ -1 & -3 \end{bmatrix}$ e $d_{ij} = -2j + 1$

18. $\begin{pmatrix} 22 & 16 \\ 22 & 18 \end{pmatrix}$

19. a) $\begin{pmatrix} 1 & -3 \\ 1 & 2 \\ 5 & 8 \end{pmatrix}$ b) $\begin{pmatrix} 0 & 6 & 18 \\ -5 & 9 & -2 \end{pmatrix}$

20. $\begin{pmatrix} 1 & 2 \\ 1 & 13 \end{pmatrix}$

21. a) 21
    b) 30

22. $X = \begin{pmatrix} 6 & 3 \\ 5 & 11 \end{pmatrix}$ e $Y = \begin{pmatrix} 8 & 3 \\ 5 & -1 \end{pmatrix}$

23. a)

	P	M	B	H	F
Aluno A	3	3	0	5	5
Aluno B	1	1	3	4	2
Aluno C	8	5	5	4	5

b) Português: aluno C
Matemática: aluno C
História: aluno A

24. a) $\begin{pmatrix} 4 & 8 & 12 \\ -12 & 20 & -4 \end{pmatrix}$ b) $\begin{pmatrix} \frac{1}{3} & \frac{2}{3} & 1 \\ -1 & \frac{5}{3} & -\frac{1}{3} \end{pmatrix}$

25. a) $\begin{pmatrix} 9 & 10 \\ 2 & 21 \\ 9 & 29 \end{pmatrix}$ b) $\begin{pmatrix} -7 & 10 \\ 4 & -13 \\ -27 & -17 \end{pmatrix}$

26. $\begin{bmatrix} -1 & -4 & -25 \\ 10 & -5 & -11 \\ 15 & 12 & -9 \end{bmatrix}$

28. $\begin{pmatrix} 9 & -1 & 1 \\ 1 & 4 & 4 \end{pmatrix}$

29. $\begin{pmatrix} 5 & 5 \\ 3 & 2 \end{pmatrix}$

30. a) $\begin{pmatrix} 24 & 5 \\ 1 & 6 \end{pmatrix}$ c) A
    b) $\begin{pmatrix} 3 & 9 & 15 \\ 6 & 0 & -9 \end{pmatrix}$ d) $\begin{pmatrix} -1 & -3 & -5 \\ -2 & 0 & 3 \end{pmatrix}$

31. $\begin{bmatrix} 1 & 3 & -2 \\ -2 & -1 & 4 \\ -2 & -8 & 10 \end{bmatrix}$

32. $\begin{pmatrix} 1 & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$

33. $X = \begin{pmatrix} 1 & 3 & -2 \\ 5 & -6 & 7 \end{pmatrix}$ e $Y = \begin{pmatrix} -4 & 2 & 0 \\ 7 & -1 & 6 \end{pmatrix}$

34. 3

35. verdadeira

36. a) $\begin{bmatrix} -2 & 5 \\ -2 & 13 \end{bmatrix}$ c) $\begin{bmatrix} 1 & 6 \\ 2 & 14 \end{bmatrix}$
    b) $\begin{bmatrix} 0 & 3 & 2 & 7 \\ -10 & 9 & 6 & -19 \end{bmatrix}$ d) Não existe.

37. a) $\begin{bmatrix} -2 \\ -4 \\ -6 \end{bmatrix}$ c) $\begin{bmatrix} -15 & 10 \\ 0 & 17 \\ 4 & 3 \\ 8 & 6 \end{bmatrix}$

b) $\begin{bmatrix} 32 & 4 \\ 43 & 2 \end{bmatrix}$ d) $\begin{bmatrix} 8 & 20 & 29 \\ 1 & 16 & 29 \\ -2 & 4 & 12 \end{bmatrix}$

38. a) $\begin{bmatrix} 12 & -4 & 16 \\ 18 & -6 & 24 \\ 30 & -10 & 40 \end{bmatrix}$ b) Não existe. c) Não existe.

39. a) $\begin{bmatrix} 11 & 4 \\ 4 & 2 \\ 10 & 3 \end{bmatrix}$ c) $\begin{bmatrix} 1 \\ 8 \\ -8 \end{bmatrix}$ e) $\begin{bmatrix} 5 & 4 & 2 \\ 6 & 6 & 1 \end{bmatrix}$

b) Não existe. d) $\begin{bmatrix} 5 \\ 3 \end{bmatrix}$

40. a) 3 b) 17 c) Não existe.

41. $x = 2; y = -4$

42. 22

43. 94

45. $x = y = -2$

46. a) $\begin{bmatrix} 7 & 10 \\ 15 & 22 \end{bmatrix}$ b) $\begin{bmatrix} 11 & 12 & 2 \\ 20 & 33 & 12 \\ 5 & 18 & 34 \end{bmatrix}$

47. a) $\begin{bmatrix} 37 & 54 \\ 81 & 118 \end{bmatrix}$ b) $\begin{bmatrix} 21 & 48 & 70 \\ 80 & 171 & 172 \\ 175 & 258 & 82 \end{bmatrix}$

48. $\begin{bmatrix} 4 & 6 & 7 \\ 9 & 3 & 2 \\ 7 & 8 & 10 \end{bmatrix} \begin{bmatrix} 7 \\ 6 \\ 5 \end{bmatrix}$ A = 99, B = 91, C = 147

49. $\begin{pmatrix} -4 & 2 \\ -64 & 19 \end{pmatrix}$.

50. $\begin{pmatrix} -9 & 17 & 2 \\ 4 & -7 & 0 \end{pmatrix}$

51. $\begin{bmatrix} -18 \\ 42 \end{bmatrix}$

52. $\begin{bmatrix} 47 & -20 \\ -73 & 31 \end{bmatrix}$

53. $A^2 = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}, A^3 = \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$ e $A^4 = \begin{bmatrix} 1 & 4 \\ 0 & 1 \end{bmatrix}$

54. $x = 7; y = 2$

55. a) V b) V c) F

56. $xy^2 = -1$

57. sim

58. $\begin{pmatrix} 0 & 1 \\ \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$

59. $\begin{pmatrix} 2 & -1 \\ -\frac{5}{2} & \frac{3}{2} \end{pmatrix}$

60. a) $\begin{pmatrix} \frac{15}{2} & -\frac{7}{2} \\ -\frac{9}{2} & \frac{5}{2} \end{pmatrix}$ b) $\begin{pmatrix} \frac{3}{2} & \frac{11}{2} \\ -1 & -4 \end{pmatrix}$

61. Não existe.

62. BA = 9I

63. a) $\begin{pmatrix} 8 & -6 \\ 4 & -8 \end{pmatrix}$ b) $\begin{pmatrix} 38 & 0 \\ 0 & 38 \end{pmatrix}$

64. $x = -1$

65. $x = 7; y = 1$

66. $\begin{pmatrix} -\frac{1}{3} & 0 & \frac{2}{3} \\ 0 & \frac{1}{3} & 0 \\ \frac{2}{3} & 0 & -\frac{1}{3} \end{pmatrix}$

67. $\begin{pmatrix} 1 & -2 & 5 \\ 0 & 1 & -4 \\ 0 & 0 & 1 \end{pmatrix}$

68. $\begin{pmatrix} -5 & -16 \\ 12 & 28 \end{pmatrix}$

69. a) $X = (C - A) \cdot B^{-1}$ b) $X = A \cdot B^{-1}$

TESTES DE VESTIBULARES

1. d	7. e	13. b	19. e
2. b	8. c	14. c	20. c
3. b	9. b	15. b	21. d
4. d	10. b	16. b	
5. c	11. d	17. a	
6. d	12. d	18. c	

20 DETERMINANTES

EXERCÍCIOS

1. a) −7 b) −13 c) 4 d) 6 e) 1

2. $x = 1$ ou $x = -2$

3. $-\frac{10}{3}$

4. $\det X = -12$

5. 0

6. a) 22 b) 2

7. a) abc b) $a - a^3$

8. $\det A = 1$, $\det B = -4$ e $\det (A + B) = 0$

9. $x > -\frac{4}{3}$

10. $\left\{x \in \mathbb{R} \mid x < 0 \text{ ou } \frac{1}{6} \leq x \leq 1\right\}$

11. a) $x = 3$ b) $-3 < a < 5$

12. $x = 13$

13. a) $M - kI = \begin{bmatrix} 2-k & 0 \\ -3 & 5-k \end{bmatrix}$ b) $k = 2$ ou $k = 5$

14. $\begin{bmatrix} 2 & -\frac{3}{4} & -\frac{5}{2} \\ 8 & -3 & -2 \\ 2 & -1 & 1 \end{bmatrix}$

15. $\{x \in \mathbb{R} \mid x < -1 \text{ ou } 0 < x < 1\}$

16. a) −452 b) 3 c) −60

17. a) 13 b) $-3a + 3d$ c) 48

18. $x = 2$ **19.** $x = 2$ **20.** -225

21. a) 0 b) 0

22. a) -7 b) 35 c) 35 d) 175

23. a) 66 b) -44 **24.** 63

25. $x = 29$ **26.** a) $\frac{1}{2}$ b) 1

27. 0 **28.** -432 **29.** -72

30. x **31.** a) $m = 3$ b) 12 **32.** -9

TESTES DE VESTIBULARES

1. a	**7.** e	**13.** a	**19.** b
2. e	**8.** e	**14.** a	**20.** b
3. b	**9.** e	**15.** e	**21.** d
4. b	**10.** a	**16.** c	**22.** a
5. b	**11.** e	**17.** b	
6. e	**12.** c	**18.** c	

21 SISTEMAS LINEARES

EXERCÍCIOS

1. sim

2. a) sim b) não c) sim

3. a) sim b) não c) não

4. $m = -\frac{15}{19}$ **5.** $m = 3$

6. Por exemplo, $(0, 0, 0, 0)$ e $(1, 1, -1, -1)$

7. Por exemplo, $(2, 2, 2)$ e $(1, 10, -1)$

8. 8 **9.** sim

10. sim **11.** não

12. b) SPI **13.** SI

14. a) $A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ e $B = \begin{bmatrix} 1 & 1 & 0 & 7 \\ 1 & 0 & 1 & 8 \\ 0 & 1 & 1 & 9 \end{bmatrix}$

b) $A = \begin{bmatrix} 4 & -1 & 1 \\ 1 & 2 & -1 \\ 1 & 0 & -1 \end{bmatrix}$ e $B = \begin{bmatrix} 4 & -1 & 1 & -1 \\ 1 & 2 & -1 & -2 \\ 1 & 0 & -1 & -5 \end{bmatrix}$

c) $A = \begin{bmatrix} 3 & 2 \\ 1 & -1 \\ 4 & 1 \end{bmatrix}$ e $B = \begin{bmatrix} 3 & 2 & -4 \\ 1 & -1 & -7 \\ 4 & 1 & 2 \end{bmatrix}$

15. a) $A = (-3 \quad 4 \quad 5 \quad 1)$ e $B = (-3 \quad 4 \quad 5 \quad 1 \quad 11)$

b) $A = \begin{bmatrix} 2 & 1 & 3 \\ -1 & 1 & 10 \end{bmatrix}$ e $B = \begin{bmatrix} 2 & 1 & 3 & -13 \\ -1 & 1 & 10 & 4 \end{bmatrix}$

16. a) $\begin{cases} 3x + 2y = 0 \\ 2x + 5y = 0 \end{cases}$ b) $\begin{cases} 5x + 7y - 2z = 11 \\ x - y + 3z = 13 \end{cases}$

17. a) SPD b) SI **18.** 10

19. a) sim b) não c) sim

20. *a* e *c*

21. a) $S = \{(-3, 7)\}$, SPD
b) $S = \{(3, 3, -4)\}$, SPD
c) $S = \{(\alpha + 7, 3\alpha + 2, \alpha), \alpha \in \mathbb{R}\}$, SPI

22. a) $S = \{(6, 0, 3, 2)\}$, SPD
b) $S = \{(15, 8 + 2\alpha, \alpha), \alpha \in \mathbb{R}\}$, SPI

23. a) $S = \{(3 - \alpha - \beta, \beta, \alpha), \alpha, \beta \in \mathbb{R}\}$
b) $S = \left\{\left(\frac{9 + \beta}{2}, \beta, 2 - \alpha, \alpha\right), \alpha, \beta \in \mathbb{R}\right\}$

24. $S = \{(\alpha + 1, 2\alpha - 1, \alpha), \alpha \in \mathbb{R}\}$

25. a) $\begin{cases} x + 2y = 1 \\ -8y = 8 \end{cases}$ $S = \{(3, -1)\}$ b) $\begin{cases} x + 2y = 0 \\ -y = 1 \end{cases}$ $S = \{(2, -1)\}$

26. a) $\begin{cases} 3x - 2y = 1 \\ 0x + 0y = 5 \end{cases}$ $S = \varnothing$ b) $\{x + y = 5$ $S = \{(5 - \alpha, \alpha), \alpha \in \mathbb{R}\}$

27. prato: R$ 15,00; sobremesa: R$ 5,00

28. 5 **29.** 5

30. a) $\begin{cases} x + 2y + z = 9 \\ y + z = 5 \\ 2z = 4 \end{cases}$ $S = \{(1, 3, 2)\}$ b) $\begin{cases} x + y = 3 \\ y - z = -1 \\ 2z = -2 \end{cases}$ $S = \{(5, -2, -1)\}$

31. a) $\begin{cases} x - y - 2z = 1 \\ -y + 3z = -3 \\ -z = 3 \end{cases}$ $S = \{(-11, -6, -3)\}$

b) $\begin{cases} x + 3y + 2z = 2 \\ 4y + 2z = 2 \\ 0y + 0z = \text{constante} \neq 0 \end{cases}$

SI

32. a) $S = \left\{\left(\frac{\alpha - 1}{2}, \frac{5 - 3\alpha}{2}, \alpha\right), \alpha \in \mathbb{R}\right\}$
b) $S = \left\{\left(\frac{19}{30}, \frac{1}{6}, \frac{7}{30}\right)\right\}$
c) $S = \varnothing$
d) $S = \{(1, 3, -2, 4)\}$

33. a) não b) $x = y = z = 1$

34. a) $S = \{(-1, 2, -2)\}$ b) $S = \varnothing$

35. 14

36. R$ 1 900,00

37. $a = 1; b = 3; c = 2$

38. a) $S = \{(7, 3)\}$ b) $S = \{(1, 5)\}$

39. a) $S = \{(5 - \alpha, 2, \alpha), \alpha \in \mathbb{R}\}$ b) $S = \emptyset$

40. a) SPD, $S = \{(0, 0)\}$
b) SPD, $S = \{(0, 0)\}$
c) SPI, $S = \{(3y, y), y \in \mathbb{R}\}$

41. a) SPD, $S = \{(0, 0, 0)\}$
b) SPI, $S = \{(-\alpha, \alpha, \alpha), \alpha \in \mathbb{R}\}$

42. a) $m = 1$ b) $S = \{(0, 0)\}$

43. a) $m = 2$ b) $S = \{(-11\alpha, 9\alpha, 5\alpha), \alpha \in \mathbb{R}\}$

44. a) $S = \{(0, 0)\}$
b) $S = \left\{\left(-\frac{9\alpha}{7}, -\frac{2\alpha}{7}, \alpha\right), \alpha \in \mathbb{R}\right\}$

45. a) $\lambda = 1$ ou $\lambda = -2$
b) $S = \{(\alpha, \alpha, \alpha), \alpha \in \mathbb{R}\}$

46. $m \neq -1$

47. a) $\begin{cases} x - 2y = 0 \\ (m + 4)y = 0 \end{cases}$ b) $m = -4$

48. a) $\lambda = 1$ ou $\lambda = 3$
b) $\lambda = 1 \rightarrow X = \begin{bmatrix} x \\ -x \end{bmatrix}, x \in \mathbb{R}$

$\lambda = 3 \rightarrow X = \begin{bmatrix} 0 \\ y \end{bmatrix}, y \in \mathbb{R}$

49. a) $S = \left\{\left(2, -\frac{1}{2}\right)\right\}$
b) $S = \left\{\left(\frac{3}{5}, -\frac{4}{5}\right)\right\}$
c) $S = \{(2, 1)\}$

50. a) $S = \{(1, 1, -1)\}$ b) $S = \{(-2, 3, 0)\}$

51. a) $S = \{(5, -2, 3)\}$ b) $S = \{(2, -2, 1)\}$

52. -5

53. $z = 3$

54. x = R$ 1,50, y = R$ 2,00 e z = R$ 1,20
(sorvete) (chocolate) (chiclete)

55. R$ 12,00

56. $S = \left\{\left(-3, -\frac{9}{14}, \frac{9}{17}\right)\right\}$

57. $a = 2; b = 0$

58. $S = \left\{\left(\frac{ac + bd}{a^2 + b^2}, \frac{ad - bc}{a^2 + b^2}\right)\right\}$.

59. 20 g

60. a) $\begin{cases} x + y + z = 0{,}5 \\ 5x + 20y + 16z = 5{,}75 \\ y = \frac{1}{3} \cdot (x + z) \end{cases}$
b) x = 250 g; y = 125 g; z = 125 g

61. $x = 1; y = 1; z = -2$

62. a) $\begin{cases} m \neq 2 \rightarrow \text{SPD} \\ m = 2 \rightarrow \text{SPI} \end{cases}$
b) $\begin{cases} m \neq -1 \rightarrow \text{SPD} \\ m = -1 \rightarrow \text{SI} \end{cases}$
c) $\begin{cases} m \neq -1 \text{ e } m \neq 3 \rightarrow \text{SPD} \\ m = -1 \rightarrow \text{SPI} \\ m = 3 \rightarrow \text{SPI} \end{cases}$

63. a) $\begin{cases} a \neq 1 \text{ e } a \neq -1 \rightarrow \text{SPD} \\ a = 1 \rightarrow \text{SPI} \\ a = -1 \rightarrow \text{SPI} \end{cases}$
b) $\begin{cases} a \neq 1 \text{ e } a \neq -1 \rightarrow \text{SPD} \\ a = 1 \rightarrow \text{SPI} \\ a = -1 \rightarrow \text{SI} \end{cases}$

64. a) $\begin{cases} m \neq \frac{1}{2} \text{ e } m \neq -1 \rightarrow \text{SPD} \\ m = \frac{1}{2} \rightarrow \text{SI} \\ m = -1 \rightarrow \text{SI} \end{cases}$
b) $\begin{cases} m \neq -2 \text{ e } m \neq 2 \rightarrow \text{SPD} \\ m = -2 \rightarrow \text{SI} \\ m = 2 \rightarrow \text{SPI} \end{cases}$

65. $\begin{cases} m = 1 \rightarrow \text{SPD} \\ m = -2 \rightarrow \text{SPD} \\ m \neq 1 \text{ e } m \neq -2 \rightarrow \text{SI} \end{cases}$

66. a) $\begin{cases} a \neq 0 \text{ e } a \neq 1 \rightarrow \text{SPD} \\ a = 0 \rightarrow \text{SI} \\ a = 1 \rightarrow \text{SPI} \end{cases}$
b) $\begin{cases} a \neq 1 \text{ e } a \neq -\frac{1}{2} \rightarrow \text{SPD} \\ a = 1 \rightarrow \text{SPI} \\ a = -\frac{1}{2} \rightarrow \text{SI} \end{cases}$

67. a) $\begin{cases} m \neq -1 \rightarrow \text{SPD} \\ m = -1 \rightarrow \text{SI} \end{cases}$
b) $\begin{cases} m \neq 1 \text{ e } m \neq -4 \rightarrow \text{SPD} \\ m = 1 \rightarrow \text{SPI} \\ m = -4 \rightarrow \text{SI} \end{cases}$

68. $m = 13$

69. $k = 3$

70. $k = 1$

71. $a = 2$

72. $m = \frac{1}{3}$

73. $m \neq -\frac{1}{3}$ e $m \neq 1$

74. $m = -1$

75. a) $m \neq -3$ b) $S = \{(3\alpha, -\alpha, \alpha), \alpha \in \mathbb{R}\}$

76. $\begin{cases} a \neq -2 \rightarrow \text{SPD} \\ a = -2 \text{ e } b = 6 \rightarrow \text{SPI} \\ a = -2 \text{ e } b \neq 6 \rightarrow \text{SI} \end{cases}$

77. $a = 2$

78. a) $a = 5$ e $b = 6$
b) Para $a = 5$ e $b = 6$, a reta $5x + 10y = 25$ e a reta $3x + 6y = 15$ coincidem.

79. a) $S = \left\{\left(\frac{13}{2}, \frac{1}{2}, \frac{1}{2}\right)\right\}$

b) $m = -9$ e $n = \frac{1}{3}$

80. 9 valores

TESTES DE VESTIBULARES

1. d
2. d
3. c
4. b
5. c
6. d
7. b
8. c
9. b
10. a
11. c
12. d
13. e
14. a
15. a) F b) F c) V d) V e) F
16. e
17. e
18. d
19. a
20. e
21. d
22. e
23. e
24. d

22 ÁREAS DE SUPERFÍCIES PLANAS

EXERCÍCIOS

1. a) 24 cm^2 b) $6{,}25$ cm^2 c) $60\sqrt{2}$ cm^2

2. $(4\sqrt{5} + 5)$ cm e $(4\sqrt{5} - 5)$ cm

3. a) $10\sqrt{21}$ cm^2 b) 128 m^2 c) $54\sqrt{3}$ m^2

4. a) $16x^2$ b) x^2 c) $8x^2$

5. a) 8 cm^2 b) $\frac{16}{5}$ cm^2

6. a) 16 cm e 32 cm b) 16 cm^2 e 64 cm^2

7. As três figuras são equivalentes.

8. $\frac{5}{6}$

9. $\begin{vmatrix} 5 & 2 \\ 4 & 3 \end{vmatrix}$ é uma das matrizes pedidas.

10. a) $60 + 8\sqrt{5}$ b) $6\sqrt{6}$ cm^2

11. 11 cm

12. a) 110 b) 1 764 m^2; 168 m

13. a) 30 000 pessoas b) 560 000 habitantes

14. a) $f(x) = x(50 - x)$
    $x = 10$ cm ou $x = 40$ cm
    b) 625 cm^2

15. a) 12 cm^2 b) $7\sqrt{15}$ cm^2 c) $\frac{\sqrt{3}}{3}$ m^2 d) $\frac{25\sqrt{3}}{2}$ cm^2 e) $825\sqrt{2}$ cm^2 f) $10\sqrt{3}$ dm^2

16. $\frac{1\,155}{16}$ cm^2

17. a) $\frac{27}{4}\sqrt{15}$ b) $5\sqrt{39}$ m^2 c) $4\sqrt{3}$ cm^2 d) 96 dm^2

18. a) $3\sqrt{399}$ cm$^2 = A_{\triangle} < A_{\square} = 60$ cm^2
    b) $40\sqrt{3}$ cm$^2 = A_{\triangle} > A_{\square} = 68$ cm^2

19. 8 cm

20. 60°

21. 4 cm^2

22. a) r^2 sen 2β b) 45°

23. $\{x \in \mathbb{R} \mid x > 4\}$

24. a) $4\sqrt{3}$ b) $2\sqrt{3}$

25. $\frac{2}{3}$ cm

26. 10

27. 54 cm^2

28. 48 cm^2

29. a) $\frac{3\sqrt{2} + \sqrt{6}}{6}$ b) $\frac{3 + 2\sqrt{3}}{12}$

30. sen 36° + sen 72°

31. 5 cm

32. a) $36\sqrt{3}$ cm^2 b) $\frac{252}{5}$ cm^2 c) $9\sqrt{3}$ cm^2 d) $\frac{63}{5}$ cm^2
    dimensões dobradas → áreas duplicadas

33. a) $\frac{125}{2}$ cm^2 b) $\frac{17\sqrt{55}}{4}$ cm^2 c) 24 cm^2 d) $7{,}5$ cm^2 e) $6\sqrt{3}$ cm^2

34. 64 m

35. $\frac{15\sqrt{6}}{2}$ cm^2

36. 120 dm^2

37. 45 cm^2

38. a) 3 cm b) $\frac{3}{2}$

39. a) $54\sqrt{3}$ cm^2 b) $864\sqrt{3}$ cm^2 c) 2,5 ℓa d) 4 ℓa

41. São iguais.

42. a) $18\sqrt{3}$ cm^2 b) $10\sqrt{3}$ cm

43. a) $3\sqrt{2 + \sqrt{3}}$ b) $\frac{31}{2}$

44. a) 36π dm^2 b) $\frac{36}{\pi}$ dm^2 c) 4π cm^2 d) 100π cm^2

45. 3,38 cm

46. $1\,250\pi$ m^3

47. a) 6π cm^2 b) 3π cm^2 c) 5π cm^2 d) 12π cm^2 e) 9π cm^2 f) 18π cm^2

48. a) $\frac{5\pi^2}{4}$ cm^2 b) $\frac{5\pi}{2}$ c) 8π cm^2 d) $\frac{81\pi}{2}$ cm^2

49. 2,4 m **50.** $\frac{25\pi}{16}$ cm² **51.** $18(2\pi - \sqrt{3})$ cm²

52. a) $\frac{2\,592}{5}(2\pi - 5 \text{ sen } 72°)$ mm²
b) $\frac{20\,736\pi}{5}$ mm²
c) $\frac{20\pi - 12}{3}$ cm²
d) $\frac{75\pi^2}{4}(4 - \pi)$ cm²

53. $2(2\sqrt{3} - \pi)$ cm²

54. $\pi \frac{m^2}{4}$ **55.** $8(\pi - \sqrt{3})$ cm²

56. R$ 19 315,00 **57.** a) $2(3\sqrt{3} - \pi)$ b) 4π

58. $\frac{\sqrt{2}}{2}$ **59.** 30,5 m²

60. $\frac{\sqrt{3}}{3}$ **61.** $\frac{2\sqrt{15}}{3}$ cm

62. $\frac{96}{25}$ cm² **63.** 44,4% **64.** 5

TESTES DE VESTIBULARES

1. a **2.** c **3.** d **4.** c **5.** e **6.** a **7.** d **8.** c

9. e **10.** b **11.** c **12.** c **13.** e **14.** b **15.** d **16.** c

17. d **18.** e **19.** c **20.** a) V b) V c) V d) F **21.** c **22.** e

23. e **24.** b **25.** a **26.** d **27.** b **28.** c **29.** e

23 GEOMETRIA ESPACIAL DE POSIÇÃO

EXERCÍCIOS

1. a) F b) V c) V d) V e) V f) V g) F h) V i) F j) F

2. quatro planos: (A, B, C); (A, B, D); (A, C, D); (B, C, D)

3. Três extremidades de pés estão necessariamente num mesmo plano; o quarto pé pode não ter a extremidade no mesmo plano.

4. um único plano **5.** um ou três planos

6. quatro planos: (A, B, C); (A, C, D); (A, B, D); (B, C, D)

7. a) V b) F c) V d) F

8. a) *r* e *s* são concorrentes.
b) *r* e *s* coincidem (também com *t*).
c) $r // s$ ou *r* e *s* são reversas.

9. a) um ponto
b) uma reta
c) $\alpha = \beta$
d) um plano; três retas ou três retas; um plano
e) coplanares; paralelas
f) concorrentes; paralelas ou paralelas; concorrentes

10. a) $r \subset \alpha$
b) $r // \alpha$
c) *P* é o traço de *r* em α; *r* e α são secantes.

11. a) V; secantes b) F c) V; paralelos d) V; reta contida no plano

12. a) paralelas ou reversas
b) concorrentes ou reversas

13. a) V b) V c) F d) V e) F f) V

14. a) F b) F c) V d) V

15. São retas paralelas.

16. a) 1. paralelas 2. concorrentes 3. reversas 4. reversas 5. secantes 6. paralelos 7. paralelos

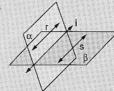
17. São concorrentes.

18. paralelas ou reversas

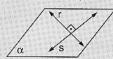
19. a) V b) V c) F d) V

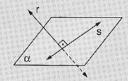
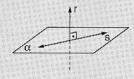
20. a) V b) F c) V d) V

21. a) V b) F c) F d) F

22.

"Se duas retas paralelas estão contidas em planos secantes — cada reta em um único plano — as retas são paralelas também à interseção dos planos."

23. A afirmação é falsa, pois *r* pode assumir qualquer das três posições em relação a α:

r contida em α

r oblíqua a α

r perpendicular a α

24. F

25. a) $r \cap s = \{B\}; r \cap \alpha = \{A\}; s \cap \alpha = \{P\}$
$s \perp \alpha$; $\triangle ABP$ é retângulo $\Rightarrow r \not\perp \alpha$
b) $r \cap s = r \cap t = r \cap \alpha = \{P\}$
$r \perp s; s \subset \alpha; r \perp t; t \subset \alpha \Rightarrow r \perp \alpha$
c) $\alpha \cap \beta = \{i\}; r \cap \alpha = r \cap \beta = r \cap i = \{P\}$
r e *s* são reversas
s, *t* e *i* são concorrentes duas a duas
$r \perp t; t \subset \alpha$

26. a) F b) F c) V d) V

27. a) $\perp$ b) //; // c) (//; $\subset$) ou ($\subset$; //) d) $\perp$ e) // f) (//; $\subset$) ou ($\subset$; //)

28. a) F b) F c) F d) F e) F f) V

29. dois pontos distintos ou duas retas paralelas ou duas retas coincidentes

30. a) perpendiculares
b) É igual à medida do diâmetro do círculo maior.

31. $AC = d_{A, C}$
$BC = d_{B, C} = d_{C, \overleftrightarrow{AB}} = d_{r, \overleftrightarrow{AB}}$
$AB = d_{A, B} = d_{A, \pi} = d_{A, \overleftrightarrow{BC}}$

32. a) F b) F c) F d) V e) F f) V

TESTES DE VESTIBULARES

1. b 2. c 3. d 4. d 5. e 6. b 7. b 8. a 9. e 10. e 11. c

24 ANÁLISE COMBINATÓRIA

EXERCÍCIOS

1. 24

2. a) 256 b) 128

3. 18

4. a) 4 096 b) 2 048 c) 840 d) 210

5. a) 90 000 b) 45 000 c) 13 776

6. 7

7. 14

8. a) 160 b) 736

9. 4
(k, k); (k, c); (c, k) e (c, c), sendo *k*: cara e *c*: coroa.

10. 8

11. 16

12. a) 840 b) 360 c) 1 680

13. a) 6 500 000 b) 406 250 c) 10 080

14. 24

15. X: 24; Y: 72

16. 81

17. a) 168 b) 55 c) 108

18. a) 216 b) 120 c) 24 d) 32

19. a) 2 520 b) 9 072

20. F; o número de possibilidades é 60.

21. a) 81 b) 117 c) 6 d) 9

22. a) 16 b) 48

23. 1

24. a) V b) V c) F; 180 d) V

25. 262 144 junções

26. a) 720 b) 24 c) 2 d) 4 e) 4 920

27. a) 56 b) 2 730 c) $\frac{1}{10}$ d) $\frac{9}{20}$ e) 2 008

28. a) 21 b) $\frac{8}{7}$ c) 190 d) 840 e) $\frac{1}{2}$

29. a) $\frac{111}{10}$ b) $\frac{39}{1\,640}$ c) 90 d) 360 e) 0

30. a) $n^2 + 5n + 6$ b) $\frac{1}{n}$ c) $n + 2$ d) $-n$ e) $\frac{n^2}{(n+1)!}$ f) $\frac{(n-1)^2}{n}$

31. a) $S = \{4\}$ b) $S = \{7\}$ c) $S = \{9\}$ d) $S = \{4\}$ e) $S = \{5, 6\}$ f) $S = \{4\}$

32. S = {5}

33. 90

34. 380

35. a) 32 292 000 b) 1 723 680

36. a) 210 b) 110 c) 5 d) 120 e) $\frac{1}{168}$

37. 95 040

38. 168

39. a) 720 b) 72 c) 504

40. 5 860

41. 24

42. a) S = {11} b) S = {7} c) S = {3}

43. a) 336 b) 60 c) 126 d) 180

44. a) 120 b) 30

45. a) 6 b) 24 c) 720 d) 362 880

46. 24

47. a) 362 880 b) 161 280 c) 100 800 d) 5 040 e) 181 440

48. a) 120 b) 24

49. a) 48 b) 48 c) 6

50. a) 120 b) 5 040 c) 8 d) $\frac{1}{90}$

51. a) 12! b) $36 \cdot 10!$ c) $2 \cdot (6!)^2$ d) $(6!)^2$

52. 103 680

53. a) S = {4} b) S = {23}

54. 576

55. 293ª posição

56. a) 720; 120 b) 481ª posição; 312 465

57. 126

58. a) 10 b) 6

59. 2 160

60. a) 270 725 b) 28 561 c) 715

61. a) 24 b) 4 804 c) 1 275 d) 17 296

62. a) 165 b) 84 c) 20 d) 0 e) 16

63. a) 186 b) 20

64. a) 4 725 b) 792 c) 86

65. a) 84 b) 28 c) 42

66. a) S = {17} b) S = {5} c) S = {10}

67. 231

68. a) 45 b) 120 c) 792

69. 70

70. 6

71. 666

72. a) 1 512 b) 336

73. a) 24 b) 288 c) 3 744

74. 10

75. a) 106 b) 11

76. a) 2 520 b) 60 c) 60 d) 12 e) 10 080 f) 151 200 g) 10 080 h) 75 600

77. a) 1 024 b) 120

78. a) 1 b) 4 c) 12

79. 12 600

80. a) 420 b) 90

81. a) 5 040 b) 8 400 c) 7 560 d) 2 520

82. 43 758

TESTES DE VESTIBULARES

1. b
2. a
3. e
4. c
5. c
6. d
7. b
8. b
9. b
10. d
11. d
12. b
13. a
14. a) V b) V c) V d) F
15. c
16. d
17. c
18. e
19. e
20. a
21. d
22. c
23. c
24. b
25. c

25 PROBABILIDADE

EXERCÍCIOS

1. Ω = {Sul, Sudeste, Centro-Oeste, Nordeste, Norte}

2. a) Ω = {1, 2, 3, 4, 5, 6} b) E_1 = {3, 6} c) E_2 = {1, 4, 6}

3. a) 36 b) 5 c) 9

4. 1 326

5. a) 8
b) {(K, K, K); (K, K, C); (C, K, K); (C, K, C)}
c) {(K, C, C); (C, K, C); (C, C, K)}

6. a) 32 b) 496 c) 4 960

7. 255

8. 93

9. E^c = {1, 5, 7, 11, 13, 17, 19, 23, 25, 29, 31, 35, 37}

10. a) $\frac{1}{100}$ b) $\frac{37}{100}$ c) $\frac{9}{10}$

11. a) $\frac{1}{10}$ b) $\frac{1}{10}$ c) 0 d) $\frac{1}{2}$ e) $\frac{2}{5}$

12. a) $\frac{1}{52}$ b) $\frac{1}{4}$ c) $\frac{12}{13}$

13. $\frac{9}{20}$

14. a) $\frac{1}{6}$ b) $\frac{5}{6}$ c) $\frac{1}{6}$ d) $\frac{1}{2}$ e) $\frac{3}{4}$

15. a) a = 22; b = 31; c = 106; d = 48; e = 71
b) $\frac{31}{200}$
c) $\frac{81}{200}$

16. a) 60% b) 30% c) 10%

17. a) $\frac{1}{9}$ b) $\frac{1}{3}$

18. 80%

19. 14%

20. a) 37,5% b) 87,5%

21. a) 96 b) 58%

22. 7%

23. a) 0 b) $\frac{1}{2}$ c) 1

24. a) $\frac{2}{13}$ b) $\frac{101}{148}$

25. 65%

26. $\frac{1}{24}$

27. $\frac{18}{25}$

28. a) 0,148% b) 50,4%

29. a) 1% b) 1%

30. $\frac{28}{57}$

31. 1%

32. a) $\frac{1}{5}$ b) $\frac{11}{295}$

33. a) 3 150 b) $\frac{18}{35}$

34. a) $\frac{1}{10}$ b) $\frac{1}{15}$

35. a) $\frac{51}{884}$ b) $\frac{11}{850}$ c) $\frac{28}{1\,105}$

36. 37,2%

37. a) 19 b) $\frac{3}{95}$

38. 0,00069%

39. a) 32,35% b) 9 ou mais

40. $\frac{3}{7}$

41. a) $\frac{2}{15}$ b) $\frac{1}{5}$

42. $\frac{2}{3}$

43. a) $\frac{4}{5}$ b) $\frac{1}{3}$ c) $\frac{1}{3}$

44. $\frac{4}{13}$

45. $\frac{31}{36}$

46. a) $\frac{17}{20}$ b) $\frac{67}{120}$

47. a) $\frac{79}{155}$

48. p = 0,13; 100p = 13

49. 30%

50. a) $\frac{7}{50}$ b) $\frac{1}{2}$

51. a) $\frac{1}{44}$ b) $\frac{2}{3}$ c) $\frac{1}{13}$

52. a) 100% b) 13,3%

53. a) $\frac{25}{99}$ b) $\frac{5}{22}$

54. a) $\frac{6}{11}$ b) $\frac{9}{11}$

55. a) $\frac{7}{20}$ b) $\frac{1}{12}$

56. a) $\frac{4}{17}$ b) $\frac{1}{4}$

57. a) $\frac{22}{117}$ b) $\frac{20}{39}$

58. 32,6%

59. a) $\frac{1}{30}$ b) $\frac{7}{40}$

60. a) 2,16% b) 72,16% c) 27,84%

61. 87%

62. a) 33% b) 83,5%

63. $\frac{1}{384}$

64. 3

65. a) 22 b) $\frac{40}{77}$

66. a) 27,34% b) 10,94%

67. a) 20,1% b) 0,55% c) 10,74% d) 89,26%

68. 16,52%

69. a) 51,2% b) 38,4%

70. a) 25,1% b) 48,2%

71. $\frac{7}{27}$ 72. $\frac{11}{32}$

73. a) 12,7% b) 23,8%

TESTES DE VESTIBULARES

1. c 8. a 15. d 22. a
2. d 9. d 16. e 23. a
3. d 10. b 17. b 24. d
4. a 11. e 18. d 25. b
5. c 12. b 19. a 26. d
6. d 13. d 20. b
7. e 14. e 21. d

26 BINÔMIO DE NEWTON

EXERCÍCIOS

1. a) 36 b) 286 c) 6 d) 10 e) 20 f) –8

2. a) 4 b) 2

3. a) 15 b) $\frac{5}{8}$ c) n = 14; p = 4

4. a) $\binom{12}{4}$ b) $\binom{22}{9}$ c) $\binom{20}{5}$ d) $\binom{24}{11}$ e) $\binom{28}{22}$

5. a) a = 1, b = 36, c = 126, d = 126, e = 36, f = 45 e g = 252
   b) 256
   É a linha de "numerador" 8.

6. a) 16 b) 31 c) 512 d) 120

7. 14 8. $\frac{17}{10}$ 9. 14

10. 8 11. S = {7} 12. 6

13. a) $x^5 + 10x^4 + 40x^3 + 80x^2 + 80x + 32$
    b) $81x^4 + 432x^3y + 864x^2y^2 + 768xy^3 + 256y^4$
    c) $1 - 10x + 40x^2 - 80x^3 + 80x^4 - 32x^5$

14. a) $81b^8 - 108b^5 + 54b^2 - \frac{12}{b} + \frac{1}{b^4}$
    b) $x^6 + 6x^4 + 15x^2 + 20 + \frac{15}{x^2} + \frac{6}{x^4} + \frac{1}{x^6}$
    c) $x^2 - 4x + 6 - \frac{4}{x} + \frac{1}{x^2}$

15. $S = \left\{\left(\frac{7}{2}, \frac{1}{2}\right)\right\}$ 16. 10^{10}

17. a) 3 125 b) 1 c) 1 d) 2^{20} e) 6 560

18. a) 1 024 b) 256 c) 0 d) 16

19. 5 20. $x^4 - 4x^2 + 6 - \frac{4}{x^2} + \frac{1}{x^4}$

21. a) $\frac{8\,064}{x^5}$ c) 3 360
    b) Não existe termo em *x*.

22. a) $\frac{1\,792}{729}x^6y^4$ b) $\frac{16}{3}xy^{14}$ 23. 210

24. a) $\binom{22}{2} \cdot 2^{20}$ b) $-\binom{22}{11} \cdot 2^{11}$

25. a) 495 b) 924 c) 1 d) Não existe.

26. 10 27. n = 10; p = 2

28. 96 29. a) 5 b) 3

TESTES DE VESTIBULARES

1. a) F b) V c) V d) F e) V
2. a
3. c 4. d 5. e 6. e 7. c
8. d 9. c 10. d 11. e 12. e
13. a 14. b 15. c 16. b 17. b

27 POLIEDROS

EXERCÍCIOS

1.

	V	A	F	Euler
a)	10	15	7	10 – 15 + 7 = 2
b)	4	6	4	6 – 4 + 4 = 2
c)	6	12	8	6 – 12 + 8 = 2
d)	7	12	7	7 – 12 + 7 = 2

2. Há 5 faces (F = 5), sendo 4 triangulares e 1 quadrangular. Assim, haveria 4 × 3 + 1 × 4 = 16 lados das faces; ao se tornarem arestas, tais lados têm a quantidade dividida ao meio: A = 8. Os vértices das faces seriam igualmente em número de 4 × 3 + 1 × 4 = 16, porém ao vértice *M* do poliedro concorrem 4 arestas e, a cada um dos outros, *A*, *B*, *C* e *D*, concorrem 3 arestas; assim, V = 16 – 3 – 4 × 2 = 5. Relação de Euler: 5 – 8 + 5 = 10 – 8 = 2.

3. Não; a relação de Euler implicaria F = 2, e não existe poliedro com 2 faces (o número mínimo de faces é 4).

4. 10 e 19 5. 10 6. 10

7. 20 8. V = 12; A = 24

9. a) 6 b) 4 c) 12

10. 20; 30 11. A = 12; V = 7

12. tetraedro, octaedro e icosaedro

13. tetraedro: 720°
hexaedro: 2 160° = 3 · 720°
octaedro: 1 440° = 2 · 720°
dodecaedro: 6 480° = 9 · 720°
icosaedro: 3 600° = 5 · 720°

14. 6 triangulares e 3 quadrangulares

15. 2 pentagonais e 5 quadrangulares

TESTES DE VESTIBULARES

1. e 2. a 3. d 4. c 5. e 6. a 7. a 8. d

28 PRISMA

EXERCÍCIOS

1. a) hexagonal b) triangular c) hexagonal d) heptagonal

2. V = 16; A = 24; F = 10
Pela relação de Euler: 16 – 24 + 10 = 2

3. $\sqrt{85}$ cm 4. $6\sqrt{2}$ cm; $6\sqrt{3}$ cm 5. 1 cm

6. a) $(x - 1)\sqrt{3}$ b) $x\sqrt{14}$

7. a) 5 cm b) $\sqrt{5}$ cm c) $\dfrac{\sqrt{7}-1}{2}$ cm

8. $\sqrt[6]{6}$

9. Como 48 cm de arame serão consumidos com as doze arestas, o único reforço como diagonal possível será a diagonal de face, pois: $\sqrt{2} \cdot 4 < 6 < \sqrt{3} \cdot 4$.

10. a) $d = 4\sqrt{3}$ cm; $A_t = 96$ cm²
b) $d = \sqrt{57}$ cm; $A_t = 112$ cm²

11. $5\sqrt{3}$ m

12. $\dfrac{\sqrt{39}}{5}$ 13. $2(\sqrt{2} + \sqrt{3})$ cm

14. $A_\ell = 90$ cm²; $A_t = (90 + 10\sqrt{3})$ cm²

15. a) $A_\ell = 9$; $A_t = 9 + \dfrac{\sqrt{3}}{2}$
b) $A_\ell = 128$; $A_t = 128 + 16\sqrt{2}$

16. a) hexagonal b) 8 cm c) $192(2 + \sqrt{3})$ cm²

17. $A_\ell = 144$ cm²; $A_t = 36(4 + 3\sqrt{3})$ cm²

18. $\sqrt{30}$ m

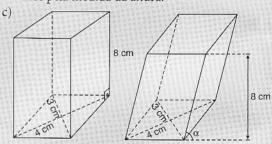
19. cubo: 96 cm²
prisma regular: $8(\sqrt{3} + 6\sqrt{2})$ cm²

20. $(70 + 12\sqrt{3})$ cm²

21. a) 125 cm³ b) 198 cm³ c) 80 cm³ d) $240\sqrt{3}$ cm³ e) $45\sqrt{3}$ cm³

22. $A_t = 9(10 + 3\sqrt{3})$ cm²; $V = \dfrac{135\sqrt{3}}{2}$ cm³

23. 80 cm²

24. a) 48 cm²
b) Não; independentemente de o prisma ser reto ou oblíquo, seu volume vale o produto da área da base pela medida da altura.
c)

25. a) $A_\ell = 24\sqrt{3}$ cm²; $A_t = (8 + 24\sqrt{3})$ cm²;
$V = 12\sqrt{3}$ cm³
b) $A_\ell = 30\sqrt{2}$ cm²; $A_t = (8\sqrt{3} + 30\sqrt{2})$ cm²;
$V = 10\sqrt{6}$ cm³

26. 2,5 cm e $\sqrt[3]{20}$ cm

27. $A_\ell = (120 + 60\sqrt{2})$ cm²; $A_t = (138 + 60\sqrt{2})$ cm²;
V = 180 cm³

28. 216 cm³ 29. $10\sqrt{15}$ m³ 30. 60 cubos

31. a) R$ 600 000,00 b) 18,98 kg

32. a) 4 cm b) 1 milhão de litros

33. 125 m² 34. 363,3 cm²

35. a) $(70 + 20\sqrt{10})$ m² b) 150 m³

36. 1 cm 37. 1 m

38. 66 cm², aproximadamente

39. O volume do prisma cuja base é o esquadro isósceles mede cerca de 15,4% a mais do que o volume do outro prisma.

40. 90 m³ 41. 72 ℓ 42. $\frac{1}{8}$

43. a) (0,4 sen θ) m³ b) 0,4 m³

TESTES DE VESTIBULARES

1. c	8. c	15. e	22. d
2. a	9. d	16. d	23. b
3. b	10. b	17. e	24. d
4. c	11. c	18. a	25. a
5. c	12. c	19. e	
6. b	13. c	20. a	
7. d	14. b	21. b	

29 PIRÂMIDE

EXERCÍCIOS

1. a) pentagonal c) heptagonal
   b) hexagonal d) pentagonal

2. a) decagonal d) pentagonal
   b) decagonal e) qualquer pirâmide
   c) Não há.

3. $A_t = 144\sqrt{3}$ cm²; $V = 144\sqrt{2}$ cm³

4. a) $9(3 + \sqrt{3})$ m² b) $3\sqrt{2}$ m 5. $\frac{80}{3}$ cm³

6. $A_t = 64(1 + \sqrt{3})$ cm²; $V = \frac{256\sqrt{2}}{3}$ cm³

7. $144\sqrt{3}$ cm²

8. a) 96 cm² c) $25(1 + \sqrt{3})$ cm²
   b) $24(3 + \sqrt{41})$ cm² d) $18(1 + \sqrt{7})$ cm²

9. a) $90\sqrt{3}$ cm³ c) Não há pirâmide.
   b) $24\sqrt{3}$ cm³ d) $12\sqrt{3}$ cm³

10. $\frac{686}{3}$ cm³

11. a) $A_t = 81(1 + \sqrt{5})$ m²; V = 243 m³ b) 243 m³

12. V = 24 m³; $A_t = 6(3 + \sqrt{41})$ m²

13. $A_t = 108\sqrt{3}$ cm²; $V = 54\sqrt{6}$ cm³

14. 35

15. a) $V = \frac{500\sqrt{3}}{3}$; $A_t = 200\sqrt{3}$
    b) $V = \frac{2\,000\sqrt{3}}{3}$; $A_t = 200(1 + \sqrt{7})$

16. a) $\frac{1}{3}$ ou 3
    b) 4 cm
    c) áreas: $3(3 + \sqrt{73})$ cm²; $27(3 + \sqrt{73})$ cm²
    razão: $\frac{1}{9}$ ou 9
    d) $\frac{1}{27}$ ou 27

17. V = 36 cm³; $A_t = 18(3 + \sqrt{3})$ cm²

18. a) $2(9 + \sqrt{3})$ cm² b) $\frac{20}{3}$ cm³

19. a) $h = 10\sqrt{a - 25}$
    b) $V = \frac{40}{3}(50 - a)^2 \cdot \sqrt{a - 25}$
    c) $25 < a < 50$

20. $9\sqrt{2}$ cm³

21. $V = \frac{64\sqrt{2}}{3}$ cm³; $A_t = 32\sqrt{3}$ cm²

22. $V = 125\left(1 + \frac{\sqrt{2}}{3}\right)$ cm³; gasto: R$ 18,50

23. $\sqrt{2}$ m 24. 5 cm 25. 380 cm²

26. $V = \frac{148\sqrt{15}}{3}$ cm³; $A_t = 212$ cm²

27. $A_t = 2(17 + 8\sqrt{17})$ cm²; $V = \frac{196}{3}$ cm²

28. 2 m 29. $\frac{h}{2}$ 30. 6 m

31. a) 26 vezes c) $104\sqrt{3}$ cm³
    b) $144\sqrt{3}$ cm²

32. 486 cm³

33. $A_t = \frac{75}{2}(13\sqrt{3} + 5\sqrt{67})$ cm²; $V = 4\,750\sqrt{3}$ cm³

34. 1,4 m³, aproximadamente

35. a) 6 − 9 + 5 = 2 b) 1,5 cm

36. $(\sqrt{15} - 1)$ m

37. $\frac{9\,500\sqrt{2}}{3}$ cm³ 38. $126\sqrt{3}$ cm³

TESTES DE VESTIBULARES

1. d
2. d
3. d
4. a
5. b
6. c
7. a
8. c
9. d
10. c
11. a
12. e
13. b
14. d
15. a
16. d
17. b
18. c
19. e

30 CILINDRO

EXERCÍCIOS

1. $10\pi(3+\sqrt{3})$ cm²; $15\sqrt{5}\pi$ cm³
2. 90π cm²; $30\sqrt{15}\pi$ cm³
3. 48π cm²
4. 72π cm³ ou 96π cm³
5. 54π cm², 54π cm³
6. 53,80 cm² e 23,22 cm³ ou 58,32 cm² e 30,96 cm³
7. a) $A_t = 50\pi(2\pi+1)$ cm²; $V = 250\pi^2$ cm³
   b) $A_t = 9(3\pi+4)$ cm²; $V = 27\pi$ cm³
   c) $A_t = 24\pi$ cm²; $V = 16\pi$ cm³
8. 42π cm²
9. $12\pi\sqrt{2}$ cm³
10. 495 g
11. $\frac{4}{\pi}$ cm
12. 104,4 mℓ
13. 20 m²; 30 m²
14. o copo grande
15. 8 cm
16. 5 cm
17. a) 72π cm³ b) 192π cm³
18. 64π
19. a) 70 cm
    b) R$ 56,52, aproximadamente
20. 22,5%
21. $V' = \frac{3}{4}V$
22. 40
23. $\sqrt{10}$ m
24. não
    $A_{embalagem} = (100 \cdot \pi + 150)$ cm²
    $A_{papel} = (100 \cdot 3 + 150)$ cm²
25. 2,23 m, aproximadamente
26. a) $A(t) = 10\,000\pi \cdot 1{,}1^t$ b) 2 dias
27. A opção correta é o cilindro de 15 cm de altura; o volume aumenta em 33,3%.
28. sim

TESTES DE VESTIBULARES

1. d
2. a
3. c
4. c
5. a
6. b
7. e
8. c
9. b
10. a
11. e
12. d
13. e
14. c
15. b
16. e
17. b
18. e
19. e

31 CONE

EXERCÍCIOS

1. a) 336π cm²; $192\pi\sqrt{7}$ cm³
   b) 384π cm²; 768π cm³
2. a) $\frac{28\pi}{3}$; $\frac{8\sqrt{35}}{81}\pi$ b) $1\,050\pi$; $2\,940\pi$; $\theta \cong 261°$
3. 96π cm³
4. $\frac{80\pi}{3}$ cm³
5. $A_\ell = 16\sqrt{5}\pi$ cm²; $A_t = 16(1+\sqrt{5})\pi$ cm²
6. $V = \frac{64\sqrt{3}}{3}\pi$ cm³; $A_\ell = 32\pi$ cm²; $A_s = 16\sqrt{3}$ cm²
7. eqüilátero
8. $A_t = 36(1+\sqrt{2})\pi$ cm²; $V = 72\pi$ cm³
9. a) 18π cm³ b) 36π cm³
10. $A_t = \frac{100\pi}{9}$ cm²; $V = \frac{250\sqrt{2}\pi}{81}$ cm³
11. H = 6 h
12. $h = r\sqrt{3}$
13. $[(\sqrt{53}+2)\pi + 14]$ cm²; $\frac{14\pi}{3}$ cm³
14. p = 42,1875%
15. a) $14\sqrt{3}$ cm b) 4,704 m²
16. a) 3 m b) R$ 111 456,00
17. 1 056 m³
18. $\frac{520\pi}{3}$ cm³
19. a) 42π cm²; $39\sqrt{3}\pi$ cm³
    b) $8\sqrt{17}\pi$ cm²; $\frac{104\pi}{3}$ cm³
20. $A_t = 9\pi(5+3\sqrt{2})$ cm²; $V = 63\pi$ cm³
21. 5 mℓ
22. a) $\frac{1}{64}$ b) 2 e 8
23. 3,75 m
24. $A_t = 32\pi(5+4\sqrt{10})$ cm²; $V = 1\,664\pi$ cm³

25. $17\pi\ cm^2$; $\frac{7\sqrt{15}\pi}{6}\ cm^3$

26. a) 30 cm e 60 cm b) $1\ 125\pi\ cm^2$

27. 2 cm 28. a) $V_s = 27r^2\ cm^3$ b) 20%

TESTES DE VESTIBULARES

1. a	6. c	11. b	16. c
2. b	7. a	12. d	17. d
3. c	8. d	13. d	18. e
4. b	9. a	14. b	
5. a	10. e	15. c	

32 ESFERA

EXERCÍCIOS

1. a) $25\pi\ cm^2$ c) $16\pi\ cm^2$ e) $100\pi\ cm^2$
   b) $36\pi\ cm^2$ d) $144\pi\ cm^2$ f) $100\pi\ cm^2$

2. 6 cm 3. $27\pi\ cm^2$ 4. $18\pi\ cm^2$

5. $A_f = 800\pi\ cm^2$; $A_c = 2\ 400\pi\ cm^2$; $V_c = \frac{32\ 000\pi}{3}\ cm^3$

6. a) A área quadruplica e o volume octuplica.
   b) A área aumenta 125% e o volume aumenta 237,5%.

7. $\frac{256\pi}{3}\ cm^3$ 8. 2 cm

9. 56 barras 10. $64\ cm^3$

11. $A_t = 273\pi\ cm^2$; $V = \frac{2\ 009\pi}{3}\ cm^3$

12. a) 4 b) R$ 378,00 13. $\frac{37\pi}{6}\ cm^3$

14. a) $64\pi\ m^2$ b) 8 cm

15. Opção III: se $n \geqslant 125$, as bolas de gude não caberiam na esfera, pela quantidade ou pela forma.

16. $2\ 304\pi\ cm^3$ 17. 4 cm

18. a) $A = \frac{16\pi}{3} \cdot a^2$ b) $V = \frac{32\pi}{27} \cdot a^3 \cdot \sqrt{3}$

19. 60π 20. a) $\frac{\pi R^2}{3}\ cm^2$ b) $\frac{4\pi R^2}{3}\ cm^2$

21. a) V b) F c) F

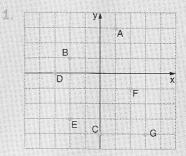
22. a) 10 b) $320\pi\ cm^2$

TESTES DE VESTIBULARES

1. c	6. c	11. b	16. e
2. c	7. c	12. c	17. b
3. c	8. a	13. b	18. c
4. a	9. a	14. a	
5. b	10. b	15. c	

33 O PONTO

EXERCÍCIOS

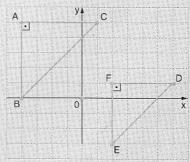
1.

2. H(2, 4); I(−2, −4); J(1, 1); K(3, 0); L(−1, 4); M(−3, −2); N(1, −3); O(0, 0); P(0, 2)

3. a) V b) F c) F d) V

4. a) positivo c) positivo
   b) negativo d) nulo

5. a) 4º Q c) 1º Q e) 4º Q
   b) 2º Q d) 4º Q

6. a) $k < 0$ c) $k > \frac{1}{2}$
   b) $0 < k < \frac{1}{2}$ d) Não há.

7.

Ambos os triângulos são isósceles.

8. $m = n = 5$

9. a) (−2, −3) c) (2, 3)
   b) (−2, 3) d) (4, −5)

10. a) $\sqrt{17}$ c) 5 e) 7
b) $5\sqrt{2}$ d) $\sqrt{130}$ f) $\sqrt{34}$

11. $5 + \sqrt{13}(1 + \sqrt{2})$

12. Falsa, pois $\sqrt{34} = \sqrt{2} \cdot \sqrt{17} \neq 2\sqrt{17}$.

13. $2\sqrt{5} + 2\sqrt{10} + 10\sqrt{2}$

14. –3

15. retângulo e isósceles

17. (0, 9)

18. (5, 5)

19. (–3, 3)

20. a) $\left(\frac{19}{10}, \frac{1}{2}\right)$ c) (–1, 3)
b) Não há. d) $\left(0, \frac{5}{2}\right)$

21. 7

22. a) $\left(\frac{3}{2}, 3\right)$ e) (7, 3)
b) $\left(\frac{5}{2}, 1\right)$ f) $\left(-2, -\frac{13}{2}\right)$
c) $\left(-2, \frac{1}{2}\right)$ g) (0, –1)
d) (0, 0) h) $\left(\frac{1}{2}, 1\right)$

23. 1

24. (–2, 0) e (0, 4)

25. (1, 7); $\sqrt{34}$

26. a) (7, –13) b) (4, –5)

27. 25

28. $\sqrt{74}$

29. $\left(-9, \frac{1}{2}\right)$; (–5, 2) e $\left(-1, \frac{7}{2}\right)$

31. (–2, 0)

32. a) sim c) não e) sim g) sim
b) não d) sim f) não h) não

33. 4

34. –2 e 5

35. 3 ou 4

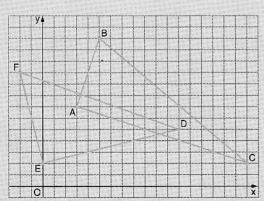
36. Não há.

37. sim

38. $\left(\frac{17}{5}, \frac{19}{5}\right)$

39. P(–5, –13)

40. 2

41.

Os triângulos, embora retângulos, não são semelhantes, pois os lados não são proporcionais.

TESTES DE VESTIBULARES

1. b	6. e	11. d	16. d
2. d	7. d	12. a	17. e
3. d	8. b	13. b	18. b
4. a	9. a	14. c	
5. b	10. c	15. a	

34 A RETA

EXERCÍCIOS

1. a) $x - 2y + 4 = 0$ c) $10x - y + 8 = 0$
b) $3x + y + 1 = 0$ d) $x - 3y - 9 = 0$

2. a) $4x - 3y = 0$ c) $y = 0$
b) $x + 2y = 0$ d) $x + 2y = 0$

3. *A*, *C* e *D*

4. a) $6x - 10y - 15 = 0$ c) $3x + y - 2 = 0$
b) $13x + 12y - 15 = 0$ d) $3x + 7y + 1 = 0$

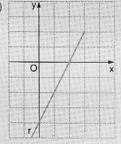
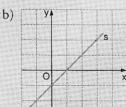
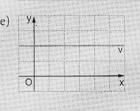
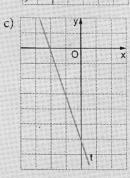
5. a) t b) s c) r d) u

6. a)

b)

c)

d)

e)

7. $2x - 1 = 0$

8. $16x + 5y - 20 = 0$

9. $m = -\frac{2}{7}; y = -\frac{2}{7}x + \frac{1}{7}$

10. r: $y = 3x + 2$; não

11. a) $y = 3x - 1$ c) $y = -x + 3$
b) $y = x + 3$ d) $y = -\frac{x}{5} - \frac{13}{5}$

12. a) s: $y = \frac{\sqrt{3}}{3}x + 2 - \frac{\sqrt{3}}{3}$ c) s: $y = \sqrt{3}x - \sqrt{3}$
b) s: $y = x + 3$ d) s: $y = -\frac{\sqrt{3}}{3}x - 3$

13. $P \notin r$ e $P \notin s$ $S \in r$ e $S \in s$
$Q \in r$ e $Q \notin s$ $T \notin r$ e $T \notin s$
$R \notin r$ e $R \in s$

14. a) 45° c) $\theta \mid tg\,\theta = 2$
b) 120° d) 135°

15. a) $m = -3$ b) $m = -3$
Conclusão: *A*, *B* e *C* estão alinhados.

16. s: $y = 3x - 7$

17. $(0, 4)$ e $\left(-\frac{12}{5}, -\frac{16}{5}\right)$

18. a) geral: $y - 2 = 0$; reduzida: $y = 2$
b) geral: $x - 2 = 0$; não há reduzida.
c) geral: $4x + 5y - 20 = 0$; reduzida: $y = -\frac{4}{5}x + 4$
d) geral: $2x + y = 0$; $y = -2x$

19. a) $\left(\frac{28}{3}, \frac{8}{3}\right)$
b) $y = \frac{2x}{7}$ ou $2x - 7y = 0$

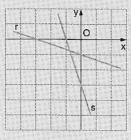
20. a) $y = y - 2 = m(x - 1)$ ou $y = 2$
b) $y + 3 = m(x - 2)$ ou $y = -3$
c) $y - 10 = mx$ ou $y = 10$
d) $y + 4 = m(x + 1)$ ou $y = -4$

21. a) $2x - y - 1 = 0$ c) $x + y - 5 = 0$
b) $2x + y - 7 = 0$ d) $y - 3 = 0$

22. a) $y + 2 = m(x + 1)$ c) $y = mx$
b) $y - 4 = m(x + 2)$ d) $y = m(x + 3)$

23. $y = \frac{2x}{3} - \frac{1}{3}$

24. geral: $2x + y + 4 = 0$
reduzida: $y = -2x - 4$
segmentária: $\frac{x}{-2} + \frac{y}{-4} = 1$

26.

27. a) não b) sim c) não d) não

28. a) r: $3x - y - 5 = 0$ c) t: $12x + 13y - 156 = 0$
b) s: $x + 7y - 4 = 0$ d) u: $2x - y - 5 = 0$

29. a) $\left(-\frac{3}{2}, 3\right)$ c) $(3, 3)$
b) $\left(-\frac{1}{2}, \frac{5}{2}\right)$ d) $\left(\frac{6}{5}, 0\right)$

30. Não há.

31. a) 1 b) -2

32. $\left(\frac{37}{7}, -\frac{17}{7}\right)$

33. a) sim; $(1, -1)$ c) sim; $(2, -2)$
b) não d) sim; $(0, 0)$

34. $\left(\frac{7}{3}, \frac{1}{3}\right)$, $(2, 1)$ e $\left(\frac{9}{5}, \frac{3}{5}\right)$

35. $\left(\frac{12}{23}, \frac{41}{23}\right)$

36. a) F c) V
b) V

37. a) paralelas e distintas c) coincidentes
b) concorrentes d) paralelas e distintas

38. a) paralelas e distintas c) concorrentes
b) concorrentes d) paralelas e distintas

39. a) -3 b) 2 c) 4 d) -1

40. a) $3x - y + 1 = 0$ c) $x + y + 4 = 0$
b) $2x + 5y - 8 = 0$ d) $y - 5 = 0$

41. r: $2x - 3y \pm 8 = 0$

42. a) $k = -\frac{9}{2}$ c) Não existe *k*.
b) $k \neq -\frac{9}{2}$

43. $(0, 3)$, $\left(\frac{3}{2}, \frac{15}{4}\right)$ e $\left(\frac{7}{2}, \frac{3}{4}\right)$

44. trapézio

45. Qualquer valor real, exceto $-1, -\frac{2}{3}, 0$ e $-\frac{5}{8}$.

47. retas *r* e *t*

48. a) $y = -\frac{1}{3}x - \frac{7}{3}$ c) $y = \frac{5}{2}x - 8$
b) $y = -\frac{5}{2}x + 2$ d) $y = -x - 1$

49. a) $\left(-\frac{2}{5}, -\frac{11}{5}\right)$ c) P
b) $\left(\frac{42}{29}, -\frac{47}{29}\right)$ d) $(-1, 0)$

50. a) $y + 4 = m(x + 2)$ ou $x = -2$
b) $2x - y = 0$

51. a) $\sqrt{65}$ b) $\sqrt{65}$

52. a) $3x + 2y - 9 = 0$ c) $x - y = 0$
b) $10x - 4y + 5 = 0$ d) $40x - 48y + 11 = 0$

53. $(2, 5)$

54. $k \in \mathbb{R} - \left\{-\frac{1}{4}, -\frac{3}{2}\right\}$

55. a) $\frac{3}{10}$ b) $-\frac{13}{5}$

56. O triângulo é retângulo em *X*.

57. a) $\frac{6}{17}$ b) $\frac{1}{7}$ c) 0 d) $\sqrt{3}$

58. ± 8 59. $45°$ 60. $\frac{1}{12}$ e 3

61. $x + 2y = 0$ e $2x - y = 0$ 62. 7

64. São semelhantes (isósceles e retângulos).

65. a) $\frac{\sqrt{10}}{2}$ b) $\frac{17}{5}$ c) $\sqrt{29}$ d) 2

66. $p = 3$ ou $p = -1$ 67. $\frac{\sqrt{106}}{2}$

68. a) $\frac{1}{2}$ b) $\frac{\sqrt{2}}{2}$ 69. $\frac{3\sqrt{10}}{10}$

70. a) Os três pontos eqüidistam de *r*.
b) $r \, // \, \overleftrightarrow{PQ}$

71. a) $2x - y - 7 = 0$ ou $2x - y - 17 = 0$ b) $2\sqrt{5}$

72. 28

73. a) 11 b) $\frac{21}{2}$ c) $\frac{39}{8}$ d) $\frac{41}{2}$

74. ABC

75. a) $\frac{39}{4}$ b) 0 c) 10 d) 16 ou 32

76. 13 77. 3 78. 38

79. a) 122 500 km² b) $(0, 2)$

80. a) $(3, 2), (6, 5), (4, 7)$ b) 6

81. 6

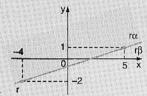
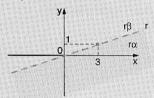
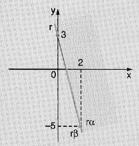
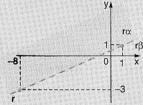
82. a) $5x - y + 1 = 0$ e $x + 5y - 2 = 0$
b) $5x + y + 3 = 0$ e $x - 5y + 5 = 0$
c) $10x - 10y - 17 = 0$ e $2x - 2y + 7 = 0$
d) $x + y - 1 = 0$ e $x - y - 5 = 0$

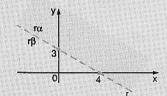
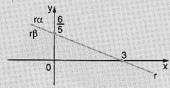
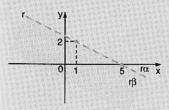
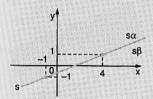
83. $y = 5x$ ou $x = -5y - 8$

84. a) $5x + 3y - 1 = 0$ e $3x - 5y + 3 = 0$
b) $4x - y + 1 = 0$ e $x + 4y - 2 = 0$
c) $r \perp s$ e $t \perp u$

85. *B*, *C* e *E* 86. $\frac{14\sqrt{2}}{3}$

87. a) $(6, 3)$ b) $(2, 11)$

88. a) $r\alpha$, incluindo *r*

b) $r\alpha$, excluindo *r*

c) $r\alpha$, incluindo *r*

d) $r\alpha$, excluindo *r*

89. a) $r\alpha$, excluindo *r*

b) rβ, incluindo *r*

c) rβ, excluindo *r*

d) rα, incluindo *r*

90. a) $5x + 3y - 15 \leqslant 0$ c) $3x - 2y + 6 \geqslant 0$
b) $x - 3y + 2 < 0$ d) $x + 3y \geqslant 0$

91. a) $\frac{7}{2}$ b) 4

92. 2

93. b) y 6 4 2 0 2 3 4 x

TESTES DE VESTIBULARES

1. c
2. a
3. b
4. b
5. b
6. a
7. a
8. d
9. c
10. a
11. b
12. b
13. a
14. d
15. a
16. b
17. b
18. c
19. d
20. d
21. a
22. c
23. c
24. a
25. a
26. d
27. b
28. b
29. a
30. e

35 A CIRCUNFERÊNCIA

EXERCÍCIOS

1. a) $C \equiv O; r = 5$ c) $C(-2, 0); r = 2$
b) $C(1, -1); r = \sqrt{5}$ d) $C(-7, -5); r = \sqrt{35}$

2. a) $x^2 + y^2 = 4$
b) $(x + 1)^2 + (y - 2)^2 = 3$
c) $(x - 2)^2 + (y + 4)^2 = 1$
d) $(x - 1)^2 + (y + 1)^2 = 8$

3. a) $(x - 3)^2 + (y - 2)^2 = 4$
b) $(x + 2)^2 + (y - 1)^2 = 1$
c) $x^2 + y^2 = 9$
d) $(x - 2)^2 + (y + 3)^2 = 16$

4. a) $(x + 2)^2 + (y + 2)^2 = 4$ c) $(x - 1)^2 + y^2 = 8$
b) $(x + 2)^2 + (y - 2)^2 = 4$ d) $x^2 + y^2 = 9$

5. a) $(x + 3)^2 + y^2 = 9$ c) $(x - 1)^2 + \left(y + \frac{7}{2}\right)^2 = \frac{5}{4}$
b) $x^2 + y^2 = 9$ d) $(x - 3)^2 + y^2 = 25$

6. a) $P(4, 2)$ b) $m = 2; y = 2x - 6$

7. $(x + 2)^2 + y^2 = 25$

8. a) não; $(x - 2)^2 + (y - 2)^2 = 10$
b) sim; não há circunferência

9. $(x + 1)^2 + (y - 1)^2 = 5$

10. a) $x^2 + (y + 1)^2 = 29$
b) $\lambda: \left(x + \frac{5}{2}\right)^2 + y^2 = \frac{145}{4}$

11. $(x - 5)^2 + (y - 2)^2 = 17$

12. 3 e −3

13. a) qualquer valor c) nenhum valor
b) 2 d) $k > 1$

14. a) $p > -2$ c) $p < -2$
b) $p = -2$ d) $\nexists\, p \in \mathbb{R}$

15. (3, 7)

16. $(x + 1)^2 + (y - 2)^2 = 9$

17. (1, 0); (5, 0)

18. 64

19. $(x \pm 3)^2 + (y \pm 3)^2 = 18$

20. a) $C(5, 1)$ e $r = 3$ e) não
b) não f) $C(-2, 2)$ e $r = 5$
c) $C(-1, -3)$ e $r = \sqrt{10}$ g) $C(10, 0)$ e $r = 1$
d) não h) não

21. a) $C(1, 2)$ e $r = \sqrt{6}$ c) $C(2, -3)$ e $r = 3$
b) $C(1, 2)$ e $r = \sqrt{6}$ d) $C(-4, 8)$ e $r = \sqrt{13}$

22. a) $(x + 1)^2 + (y - 2)^2 = \frac{1}{2}$
b) $x^2 + y^2 - 8x + 4y + 11 = 0$
c) $\left(x - \frac{5}{2}\right)^2 + \left(y - \frac{9}{2}\right)^2 = 25$
d) $x^2 + y^2 + 2x + 4y + \frac{19}{4} = 0$

23. a) $x^2 + y^2 + 2x + 8y = 0$
b) $x^2 + y^2 - 17 = 0$

24. 5

25. $x^2 + y^2 - 6x - 6y + 9 = 0$

26. a) $x^2 + y^2 + 4x - 8y - 45 = 0$
b) $x^2 + y^2 - 6x + 10y - 31 = 0$
c) $x^2 + y^2 - 2x + 2y - 2 = 0$
d) $x^2 + y^2 - 8x - 14y = 0$

27. a) $k \in \mathbb{R} \mid k > 2$ b) 57

28. $x + 5y - 3 = 0$ **29.** 5 **30.** 13

31. $p = 4$ **32.** $\frac{22}{5}$ **34.** $2\sqrt{3}$

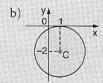
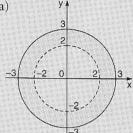
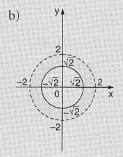
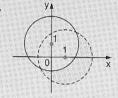
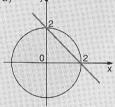
35. a) $A \in \lambda$; $F \in \lambda$
B e *D* são externos a λ; *E* é interno a λ.
b) $O \in \lambda$; *A* e *B* são externos a λ; *D* e *E* são internos a λ.

36. a) -24 c) 1
b) -1 ou 7 d) 2 ou -8

37. $3 - 2\sqrt{3} < p < 3 + 2\sqrt{3}$

38. $p \leqslant -1 - \sqrt{7}$ ou $p \geqslant \sqrt{7} - 1$

39. $(x + 2)^2 + (y - 1)^2 = 10$; interno

40. a) F c) F e) V
b) F d) F

41. a) c)
b) d)

42. a)

b)

c)

d)

43. a)

b)

44.

45.

46. a)

b)

47. O plano todo.

48. a) $\begin{cases} x^2 + y^2 + 2x - 2y - 2 \leqslant 0 \\ x^2 + y^2 - 2x + 2y - 2 \leqslant 0 \end{cases}$
b) $\begin{cases} x^2 + y^2 \geqslant 4 \\ (x - 3)^2 + y^2 \leqslant 4 \end{cases}$
c) $\begin{cases} x^2 + y^2 \leqslant 4 \\ x \geqslant 1 \end{cases}$
d) $\begin{cases} (x - 1)^2 + y^2 \leqslant 4 \\ y \leqslant 1 \end{cases}$

49. 2π

50. a) exteriores c) tangentes
b) secantes d) secantes

51. a) tangente c) tangente
b) externa d) secante

52. a) secantes c) exteriores
b) tangentes d) secantes

53. a) $(5, 5)$
b) $(5, -1)$ e $(-3, 3)$
c) Não há.
d) $(\sqrt{3}, 1 + \sqrt{3})$ e $(-\sqrt{3}, 1 - \sqrt{3})$

54. a) $4\sqrt{2}$ b) $3\sqrt{10}$

55. secante

56. $p = \pm 2\sqrt{5}$

57. a) $k = -11$ ou $k = 1$ b) $-11 < k < 1$ c) $k < -11$ ou $k > 1$

58. a) $k = -8$ b) $-8 < k < 1$ c) $k < -8$

59. a) V b) V c) V d) F e) F

60. $m = 1$; $2r = 20\sqrt{2}$

61. $(1, -1)$

62. a) $(2, 1)$ b) $\left(\frac{6-\sqrt{2}}{2}, \frac{2-\sqrt{2}}{2}\right)$

63. $k = 4$

64. a) $x - 3y + 5 \pm 3\sqrt{10} = 0$
b) $3x - 2y + 2 \pm \sqrt{13} = 0$
c) $2x - y \pm 2\sqrt{5} + 1 = 0$
d) $2x + y \pm 3\sqrt{5} = 0$

65. $x - y - 2 \pm 2\sqrt{2} = 0$

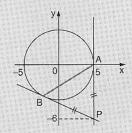
66. a) $y + 2 = 0$ ou $y - 8 = 0$
b) $x + 3 = 0$ ou $x - 7 = 0$
c) $4x + 3y + 8 = 0$ ou $4x + 3y - 42 = 0$

67. a) $x + y - \sqrt{2} = 0$ ou $x - y - \sqrt{2} = 0$
b) $x + y + 8 - 4\sqrt{2} = 0$
c) $4x + 3y - 8 = 0$ ou $y + 4 = 0$
d) $y - 6 = 0$ ou $x - 1 = 0$
e) $3x + 4y = 0$
f) Não há.

68. $(x-4)^2 + \left(y + \frac{15}{8}\right)^2 = \left(\frac{17}{8}\right)^2$

69. $\sqrt{3} \cdot x - y - 2(\sqrt{3} \pm 4) = 0$

70. $AB = \frac{60\sqrt{61}}{61}$

TESTES DE VESTIBULARES

1.	b	**7.**	a	**13.**	b	**19.**	a
2.	e	**8.**	a	**14.**	c	**20.**	b
3.	a	**9.**	b	**15.**	e	**21.**	e
4.	b	**10.**	d	**16.**	a	**22.**	b
5.	c	**11.**	a	**17.**	d		
6.	c	**12.**	c	**18.**	d		

36 AS CÔNICAS

EXERCÍCIOS

1. a) $\frac{x^2}{169} + \frac{y^2}{25} = 1$ b) $\frac{x^2}{100} + \frac{y^2}{36} = 1$ c) $\frac{x^2}{25} + \frac{y^2}{169} = 1$

2. a) $(-12, 0)$ e $(12, 0)$ b) $(-8, 0)$ e $(8, 0)$ c) $(0, -12)$ e $(0, 12)$

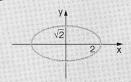
3. $\frac{x^2}{225} + \frac{y^2}{81} = 1$

4. distância focal = 4
excentricidade = $\frac{\sqrt{6}}{3}$

5. $\frac{x^2}{4} + \frac{y^2}{8} = 1$

6. $\frac{x^2}{13} + \frac{y^2}{9} = 1$

7. $\left(-\frac{\sqrt{7}}{6}, 0\right)$ e $\left(\frac{\sqrt{7}}{6}, 0\right)$

8. $F_1(\sqrt{2}, 0)$ e $F_2(-\sqrt{2}, 0)$

9. $16x^2 + 15y^2 = 240$

10. 10

11. 6

12. a) $\frac{x^2}{9} - \frac{y^2}{16} = 1$ b) $\frac{y^2}{4} - \frac{x^2}{12} = 1$

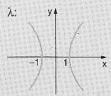
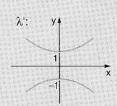
13. a) $(-5, 0)$ e $(5, 0)$ b) $(0, -4)$ e $(0, 4)$

14. 6

15. $\frac{2\sqrt{3}}{3}$

16. não

λ:

λ':

17. $(-20, 0)$ e $(20, 0)$

18. $(-\sqrt{6}, -\sqrt{2})$; $(-\sqrt{6}, \sqrt{2})$; $(\sqrt{6}, -\sqrt{2})$; $(\sqrt{6}, \sqrt{2})$

19. a) $y^2 = 4x$ b) $x^2 = 16y$ c) $x^2 = -20y$

20. $y = -\frac{7}{8}$

21. $F(4, 0)$ e $(d)\, x = -4$

22. $x^2 - 10x + 4y + 21 = 0$

23. $4y^2 = 49x$

24. elipse, $a = \sqrt{2}$, $b = \frac{\sqrt{5}}{2}$, $C(0, 0)$

25. elipse, $a = \frac{2}{3}$, $b = \frac{2}{5}$, $C(0, 0)$

26. hipérbole, $a = \frac{3}{2}$, $b = \frac{3}{7}$, $C(0, 0)$

27. parábola, $p = 14$, $V(0, 0)$, $F(0, -7)$, diretriz: $y = 7$

28. parábola, $p = 12$, $V(0, 0)$, $F(6, 0)$, diretriz: $x = -6$

29. $(1, 1)$ e $(1, -1)$

30. $\sqrt{10}$

31. dois pontos: $(0, 0)$ e $(1, 1)$

32. $p < -1 - 4\sqrt{2}$ ou $p > -1 + 4\sqrt{2}$

33. $\{(-\sqrt{7}, -\sqrt{2}), (\sqrt{7}, -\sqrt{2}), (-\sqrt{7}, \sqrt{2}), (\sqrt{7}, \sqrt{2})\}$

34. dois pontos: $(2, 2)$ e $(0, 2)$

35. $\frac{30\sqrt{17}}{17}$

36. $\sqrt{2}$

37. quatro

38. $-\sqrt{5} \leqslant m \leqslant \sqrt{5}$

39. $m \leqslant \frac{1}{2}$

40. $(0, c)$

41. $y = -x \pm \sqrt{13}$

42. $y = x + 4$; $T(1, 5)$

43. $3x - y \pm \frac{\sqrt{2}}{2} = 0$

44. 12

45. 4

46. $y = \pm\frac{\sqrt{5}}{2}x + 2$

47. $y = \pm\frac{\sqrt{6}}{12}(x - 3)$

TESTES DE VESTIBULARES

1. b
2. a
3. c
4. a) F
   b) V
   c) F
5. e
6. e
7. b
8. a
9. e
10. c
11. c
12. c
13. c
14. d
15. a
16. b

37 NÚMEROS COMPLEXOS

EXERCÍCIOS

1. a) $3 - 2i$ b) $-4 + 3i$ c) $(1, -2)$ d) $(0, 5)$ e) $4i$ f) 4 g) $(-3, 1)$ h) $(-5, 0)$

2. a) $Re = 4$; $Im = 5$ b) $Re = 3$; $Im = 3$ c) $Re = -7$; $Im = -1$ d) $Re = -\frac{1}{4}$; $Im = \frac{1}{2}$ e) $Re = -\frac{2}{3}$; $Im = \frac{5}{3}$ f) $Re = 0$; $Im = -8$

3. a) 3   b) -3 c) 5   d) -1 ou 1   e) Não existe *m* real.

4. a) 1   b) -2 c) $x < \frac{5}{2}$ d) $x < 2$

5. a) $S = \{3 + i, 3 - i\}$ b) $S = \{-10i, 10i\}$ c) $S = \{2 + 5i, 2 - 5i\}$ d) $S = \{1, -1, 2i, -2i\}$

6. $m = -4$; $n = 4$

7. $x = 3$; $y = 7$

8. $x = 1$; $y = 2$

9. a) $1 - i$ b) $-10 + 7i$ c) $4 + 2i$ d) $1 + 6i$

10. a) $z_1 = -2 + xi$; $z_2 = y - 3i$ b) $x = 5$; $y = -2$

11. $x = -1$; $y = 3$

12. $z_1 = 3 + 2i$; $z_2 = -7 + 5i$

13. a) $7 + 3i$ b) $-11 - 2i$ c) $45i$ d) $12 - 3i$ e) $9 - 2i$ f) $11 - 7i$

14. $25 - 50i$

15. a) 2   b) $-5 - 12i$ c) $15 + 8i$ d) $2i$ e) 32   f) $-2 - 2i$

16. $x = \frac{7}{5}$; $y = -\frac{6}{5}$

17. a) $\sqrt{2}$ ou $-\sqrt{2}$ b) 0

18. $(x = 2$ e $y = 2)$ ou $(x = -2$ e $y = -2)$

19. $z_1 = -2i$; $z_2 = 3 + 6i$

20. $z = -3 - 4i$

21. $z = 1 + i$ ou $z = -1 - i$

22. a) $1 - 2i$ b) $3i$ c) $5 + 5i$ d) $8i$ e) $-3 + 4i$ f) $-1 + i$

23. $z = 3 + 3i$

24. a) 36
    b) $1, 1 + i, 1 + 2i, 1 + 3i, 1 + 4i, 1 + 5i$

26. $z = i$ ou $z = -2i$

27. Qualquer número complexo $z = a + bi$ com $a = 0$ ou $b = 0$.

28. a) $-\frac{19}{25} - \frac{33}{25}i$ b) $-1 + i$ c) $\frac{3 + i}{10}$ d) $\frac{15 + 8i}{17}$ e) $-\frac{5i}{6}$ f) $\frac{10}{13} - \frac{15}{13}i$

29. a) $\frac{3}{25} + \frac{4}{25}i$ c) $\frac{4}{25} - \frac{3}{25}i$

b) $\frac{-7}{625} - \frac{24}{625}i$

30. $a = 6$

31. $m = -2; z = 2$

32. a) $a = -1$ ou $a = 2$ c) $a = -1$

b) $a = \frac{2}{3}$

33. a) $a = \frac{4}{5}; b = \frac{3}{5}$ b) $a^2 + b^2 = 1$

34. a) -1 c) $-i$ e) -1

b) i d) 1 f) $-i$

35. a) $1 - i$ b) $-i$ c) -64 d) -1

36. -1

37. $-1 + i$

38. a) $i^2 = i^6 = i^{10} = i^{14} = -1$

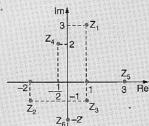
$i^3 = i^7 = i^{11} = i^5 = -i$

$i^4 = i^8 = i^{12} = i^{16} = 1$

$i^5 = i^9 = i^{13} = i$

b) Não, pois a soma dos elementos de cada coluna não é a mesma.

c) 0

39.

40. a) (2, 3) c) (4, 7) e) (−5, −12)

b) (3, −5) d) $\left(\frac{4}{5}, \frac{7}{5}\right)$

41. 12

42. a) (4, 7) b) (4, −7) c) (−7, −4)

43.

Im
1
0 3 Re

44. 6 U.A.

45. a) $\sqrt{5}$ d) 3

b) 5 e) $\frac{3\sqrt{2}}{2}$

c) 5 f) 2

46. $a = -2$ ou $a = 2$

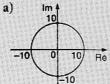
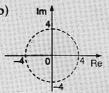
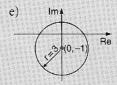
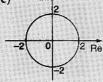
47. a)

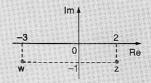
b)

c)

d)

Im
1
0 1 2 Re
−1

e)

48. a) $-7 + i; 5$

b) $b = 7$

49. $z = 2i$ ou $z = -2$

50. a) 16 b) 12

51. a) 30° d) 225° g) 0°

b) 210° e) 90° h) 150°

c) 300° f) 180°

52. Todos os números complexos têm módulo igual a 4 e seus argumentos são, respectivamente: 0°, 60°, 120°, 180°, 240° e 300°.

53. a) $z = \sqrt{2}(\cos 45° + i \operatorname{sen} 45°)$

b) $z = 2(\cos 225° + i \operatorname{sen} 225°)$

c) $z = 2(\cos 300° + i \operatorname{sen} 300°)$

d) $z = 5(\cos 150° + i \operatorname{sen} 150°)$

e) $z = 4(\cos 180° + i \operatorname{sen} 180°)$

f) $z = \cos 270° + i \operatorname{sen} 270°$

g) $z = 8(\cos 0° + i \operatorname{sen} 0°)$

54. a) $z = \frac{1}{2} - \frac{1}{2}i$ e $z = \frac{\sqrt{2}}{2}(\cos 315° + i \operatorname{sen} 315°)$

b) $\frac{1}{2}(\cos 270° + i \operatorname{sen} 270°)$

55. $z_1 = 3(\cos 90° + i \operatorname{sen} 90°)$

$z_2 = 5(\cos 150° + i \operatorname{sen} 150°)$

$z_3 = 5(\cos 315° + i \operatorname{sen} 315°)$

56. a) $-2 + i2\sqrt{3}$ c) $-\frac{\sqrt{3}}{2} - \frac{1}{2}i$

b) $3i$ d) $-1 + i$

57. $z_1 = 5\sqrt{2}\left(\cos \frac{\pi}{4} + i \operatorname{sen} \frac{\pi}{4}\right)$

$z_2 = 5\sqrt{2}\left(\cos \frac{3\pi}{4} + i \operatorname{sen} \frac{3\pi}{4}\right)$

$z_3 = 5\sqrt{2}\left(\cos \frac{5\pi}{4} + i \operatorname{sen} \frac{5\pi}{4}\right)$

$z_4 = 5\sqrt{2}\left(\cos \frac{7\pi}{4} + i \operatorname{sen} \frac{7\pi}{4}\right)$

58. a) B: $z = 3\sqrt{2} + i3\sqrt{2}$
C: $z = 6i$
b) F: $z = 6(\cos 225° + i \operatorname{sen} 225°)$
G: $z = 6(\cos 270° + i \operatorname{sen} 270°)$

59. a) $6(\cos 270° + i \operatorname{sen} 270°)$
b) $2(\cos 180° + i \operatorname{sen} 180°)$
c) $12(\cos 60° + i \operatorname{sen} 60°)$
d) $6(\cos 210° + i \operatorname{sen} 210°)$
e) $3(\cos 90° + i \operatorname{sen} 90°)$
f) $36(\cos 120° + i \operatorname{sen} 120°)$

60. $z_1 = 4(\cos 60° + i \operatorname{sen} 60°)$
$z_2 = 20(\cos 100° + i \operatorname{sen} 100°)$

61. a) $8i$ b) -64 c) $512(1 - i\sqrt{3})$

62. a) $2^{19}(1 + i\sqrt{3})$ c) $64(-1 + i\sqrt{3})$
b) $-\frac{1}{2} + i\frac{\sqrt{3}}{2}$ d) 729

63. z^{45}: $(1, 0)$; z^{50}: $\left(-\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$; z^{100}: $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$

64. a) $(16, 16)$ b) $16\sqrt{2}$

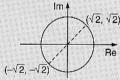
65. $n = 3$ e $n = 9$

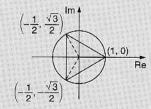
66. $n = 6; -64$

67. a) 4 096 b) 0

68. -1

69. $\frac{\sqrt{2}}{2} + i\frac{\sqrt{2}}{2}$ e $-\frac{\sqrt{2}}{2} - i\frac{\sqrt{2}}{2}$

70. a) $\sqrt{2} + i\sqrt{2}$ e $-\sqrt{2} - i\sqrt{2}$
b) 4

71. raízes: $1, -\frac{1}{2} + \frac{\sqrt{3}}{2}i, -\frac{1}{2} - \frac{\sqrt{3}}{2}i$

área: $\frac{3\sqrt{3}}{4}$

72. a) $(2, 0), (0, 2), (-2, 0)$ e $(0, -2)$
b) 8
c) $z^4 - 16 = 0$

73. $z_0 = \sqrt{3} + i$; $z_1 = -1 + i\sqrt{3}$; $z_2 = -\sqrt{3} - i$; $z_3 = 1 - i\sqrt{3}$

74. $1, \frac{1}{2} + i\frac{\sqrt{3}}{2}, -\frac{1}{2} + i\frac{\sqrt{3}}{2}, -1, -\frac{1}{2} - i\frac{\sqrt{3}}{2}$ e $\frac{1}{2} - i\frac{\sqrt{3}}{2}$

TESTES DE VESTIBULARES

1. b **2.** e **3.** b **4.** a **5.** c **6.** a **7.** d

8. d **9.** e **10.** e **11.** d **12.** a **13.** d **14.** e

15. a) V b) F c) F d) F e) V

16. c **17.** d **18.** c

19. d **20.** e **21.** b **22.** e

38 POLINÔMIOS

EXERCÍCIOS

1. a) 4 b) 3 c) 7 d) 14

2. $m \neq 2$

3. $m \neq 4$ e $m \neq -4 \Rightarrow$ grau 8
$m = 4 \Rightarrow$ grau 5
$m = -4 \Rightarrow$ grau 4

4. a) sim; $m \neq 2$ e $m \neq -2$ c) não
b) sim; $m = 2$

5. $a = -\frac{5}{2}$; $b = -2$; $c \neq \frac{1}{2}$

6. a) $m = 3$ b) Não existem $m \in \mathbb{R}$.

7. a) 3 c) -3 e) $2 - 5i$
b) -1 d) $-2 - 3i$ f) 27

8. $3; 1 + 2i$

9. a) $m = -9$ b) 5

10. $p(x) = x^2 + 4$

11. $a = 7; b = 11$

12. $p(x) = 2x^3 + x^2 + 2x$

13. $p(x) = 2x - 2$

14. a) $a = 0; b = 2$ b) $a = 0; b = -5; c = 3$

15. a) $a = -1; b = -2$ c) $a = -4; b = 1$
b) $a = 3; b = -3$ d) $a = 1; b = -1$

16. $a = b = 1$

17. 13,5

18. $a = -4; b = 3$

19. $a = 2; b = \frac{3}{4}; c = -\frac{7}{4}$

20. a) $x^3 + 2x^2 - 4x + 5$
b) $x^3 + x^2 - 2x + 5$
c) $-x^3 + 3x^2 - 3x + 7$
d) $2x^3 - 7x^2 + 10x - 8$
e) $-x^5 + x^4 - 3x^3 - 2x^2 + 5x - 4$

21. $p(x) = -5x^2 - 7x + 19$

22. $a = 4; b = -4; c = 3$

23. $(a = -1 \text{ e } b = 1)$ ou $\left(a = -2 \text{ e } b = \frac{1}{2}\right)$

24. a) O grau é 8.
b) O grau é menor ou igual a 4.
c) O grau é menor ou igual a 4.

25. a) F; o grau é 12.
b) V
c) F; o grau é menor ou igual a 7.

26. a) $p(x) = -x + 1$ b) -2

27. a) $q(x) = x + 2$ e $r = 9$
b) $q(x) = -x + 4$ e $r(x) = -6x + 5$
c) $q(x) = 5x^2 + 3x + 18$ e $r(x) = 16x + 71$
d) $q(x) = 3x^2 + 3x + 2$ e $r(x) = 3x^2 - 5x - 1$

28. a) sim; $q(x) = x - 3$
b) não; $q(x) = x^2$
c) sim; $q(x) = 2x + 1$
d) não; $q(x) = x^2 + x - 3$

29. a) $f(x) = x^4 - 3x^2 + 5x - 1$ b) não

30. a) $m = 2$ b) $m = -\frac{5}{2}$

31. a) $q(x) = x + 3i$ e $r = -6$
b) $q(x) = x^2 + (-3 - 2i)x + 6i$ e $r = 3$

32. $m = 0; n = 2$

33. $m = -5; n = 6$

34. a) 2 b) $g(x) = -2x^2 + 1$

35. a) $s(x) = x^2 - 4x + 4$
b) $S = \{x \in \mathbb{R} \mid -1 < x < 10 \text{ e } x \neq 2\}$

36. a) 14 b) 35 c) 12 d) 1

37. a) 3 b) -9 c) 12 d) -10 e) $-17 - 2i$

38. a) 4 b) -50 c) 1

39. $m = 0; n = 2$

40. $0; 6 - 6i$

41. -5

42. $-\frac{1}{2}x + \frac{5}{2}$

43. $\frac{3}{4}x + \frac{11}{4}$

44. $3x - 7$

45. 10

46. a) $q(x) = -2x^2 - 2x - 11$ e $r = -32$
b) $q(x) = 9x - 6$ e $r = 16$
c) $q(x) = x^3 - x^2 - 2x + 3$ e $r = -5$
d) $q(x) = x^2$ e $r = -1$

47. a) $q(x) = -3x^2 - 4x + 11$ e $r = 16$
b) $q(x) = -3x^2 + 11x - 29$ e $r = 121$
c) $q(x) = -3x^2 + (-1 - 3i)x + (18 - i)$ e $r = 6 + 18i$
d) $q(x) = -3x^2 - x + 15$ e $r = 5$

48. -6

49. -5

50. a) $a = 3; b = 25$ b) 117

51. a) $m = -27$

52. a) $k = 3$ b) $-2x^4 + 4x^3 + 6x^2 + 5x + 1$

53. 0

54. sim; sim; sim; não

55. $m = -8; n = 12$

56. sim; sim; sim

57. $n = 3$

58. b) $m = -25; n = 60$

59. sim; não; não

TESTES DE VESTIBULARES

1. b
2. e
3. c
4. c
5. a
6. c
7. a
8. e
9. c
10. b
11. a
12. c
13. c
14. c
15. a) F b) F c) V d) V e) F
16. e
17. c
18. c
19. c

39 EQUAÇÕES ALGÉBRICAS OU POLINOMIAIS

EXERCÍCIOS

1. a) $3 + 4i, 3 - 4i; (x - 3 - 4i) \cdot (x - 3 + 4i)$
b) $2, \frac{1}{2}; 2(x - 2) \cdot \left(x - \frac{1}{2}\right)$
c) $0, 2i, -2i; x(x - 2i) \cdot (x + 2i)$

2. a) $x^3 - 4x^2 - 11x + 30 = 0$
b) $x^2 - 2x + 5 = 0$
c) $x^4 - 6x^3 + 11x^2 - 6x = 0$
d) $x^3 - 4x^2 - 2x + 20 = 0$

3. $S = \{2, 4, -9\}$

4. a) -5 b) $2, -1$

5. $S = \left\{\frac{3}{2}, -2 + i, -2 - i\right\}$

6. $S = \{1 + 3i, 1 - 3i, 5, 1\}$

7. $S = \{-i, i, 3 + 2i, 3 - 2i\}$ 8. -144

9. a) $S = \{0, 4, -6\}$
b) $S = \{0, 1 + i, 1 - i\}$
c) $S = \left\{-i\sqrt{2}, i\sqrt{2}, \frac{1}{2}\right\}$
d) $S = \left\{-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}, -\frac{1}{2}, \frac{1}{2}\right\}$
e) $S = \{-i, i, -1\}$

10. b) $-1, 1, 2$

11. a) 0
b) $a = 1; b = -7; c = 6$
c) $S = \{-3, 1, 2\}$

12. $p(x) = x^3 - x$

13. b) $x_1 = \frac{-1 + i\sqrt{23}}{2}; x_2 = \frac{-1 - i\sqrt{23}}{2}$

14. $S = \{1, -1, i, -i, -3i, 3i, 0, 5\}$

15. a) 6
b) $\frac{1}{2}, -\frac{3}{2}$
c) $\left\{x \in \mathbb{R} \mid -\frac{3}{2} < x < \frac{1}{2} \text{ ou } x > 2\right\}$

16. a) $0 \rightarrow$ multiplicidade 3
$-2 \rightarrow$ multiplicidade 4
$1 \rightarrow$ multiplicidade 2
$-6 \rightarrow$ multiplicidade 1
b) 10
c) $S = \{0, -2, 1, -6\}$

17. -1 e -2 18. a) $m = -12$ b) $\frac{3}{4}$

19. a) $x^3 + x^2 - 21x - 45 = 0$
b) $x^3 + 6x^2 + 12x + 8 = 0$
c) $x^6 - 3x^5 + 4x^4 - 6x^3 + 5x^2 - 3x + 2 = 0$

20. -2 (raiz dupla) e $\frac{1}{2}$ (raiz dupla)

21. a) 3 b) 2

22. a) $m = 875$
b) $2 + i$ e $2 - i$

23. $S = \{5, -10\}$

24. a) $a = -5; b = 3; c = 9$
b) $x = 3$ (raiz dupla); $x = -1$ (raiz simples)

25. a) $n = -m - 2$
b) $m = -1$
c) $m < -1$ e $m \neq -5$

26. a) 4
b) 8
c) 4

27. a) $x^2 - 2x + 2 = 0$
b) $x^3 - 10x^2 + 37x - 52 = 0$
c) $x^5 - 3x^4 + 2x^3 - 6x^2 + x - 3 = 0$

28. $S = \{3 + 5i, 3 - 5i, 3\}$ 29. $m = -10; n = 29$

30. $S = \{-3 + i, -3 - i, 1 + 2i, 1 - 2i\}$

31. a) $\{p \in \mathbb{R} \mid p > -2\}$
b) $r = 25p + 275; q = 84 - 6p$

32. a) $a = 1; b = -3; c = -20; d = 100$
b) $S = \{-5, 4 + 2i, 4 - 2i\}$

33. a) $z = \sqrt{2}(\cos 45° + i \text{ sen } 45°)$
$z_3 = 2\sqrt{2}(\cos 135° + i \text{ sen } 135°)$
b) $x^3 - 4x^2 + 6x - 4$

34. 5

35. $S = \left\{1 + 2i, 1 - 2i, 0, \frac{-3 + \sqrt{5}}{2}, \frac{-3 - \sqrt{5}}{2}\right\}$

36. a) 3 b) $\frac{7}{2}$ c) $\frac{6}{7}$ d) 2

37. a) $\frac{1}{6}$ e $\frac{1}{2}$ b) $m = -\frac{1}{4}$ 38. 30

39. a) -2 b) -6 c) -5 d) $\frac{2}{5}$ e) $\frac{6}{5}$

40. $7 + 3i; 5$ 41. $S = \{-3, -6, 4\}$

42. $p = -8; q = 17; r = -10$

43. a) $m = 7$ b) $1 + \sqrt{2}, 1 - \sqrt{2}, \frac{3}{2}$

44. a) 8, 10, 12 b) $m = 296; n = -960$

45. a) $S = \{3, -2, 2\}$ b) $m = -4$

46. a) $q = 10$ b) $1, 1 + 3i, 1 - 3i$

47. $S = \{-4, -2, -1\}$ 48. a) $\frac{1}{2}$ b) -3

49. a) $-3 + 4i, -3 - 4i, 2, 4$ b) $p = -102; q = 200$

50. $p = -4; q = 5; r = -4; s = 4$

51. a) $S = \left\{-\frac{1}{2}, 3 + 4i, 3 - 4i\right\}$ b) $p = 11$

52. a) $m = n = q = 0$
b) 0 é raiz tripla e 4 é raiz simples.

53. O polinômio é $x^3 - 3x^2 + 6x - 1$ e $abc = 18$.

54. $c = -8$

55. A equação tem três raízes racionais: $\frac{1}{2}, -4, 3$.

56. $S = \{-4, 2, 3\}$

57. $S = \{-2, 1, -2i, 2i\}$ 58. $S = \{-2, 3, 1\}$

59. b) $S = \{-\sqrt{3}, \sqrt{3}, 1 - \sqrt{5}, 1 + \sqrt{5}\}$

60. b) $S = \{1 + i, 1 - i, -\sqrt{2}, \sqrt{2}\}$

61. k = 1

62. $x = \frac{1 + \sqrt{33}}{2}$ ou x = 8

TESTES DE VESTIBULARES

1. e
2. d
3. e
4. a
5. b
6. b
7. a) V
   b) F
   c) F
   d) V
   e) V
8. d
9. a) V
   b) F
   c) F
   d) F
10. e
11. e
12. c
13. e
14. e
15. a) V
    b) V
    c) F
    d) V
16. d
17. a
18. a) F
    b) V
    c) F
    d) F
    e) V
19. a
20. e
21. a
22. b

40 ESTATÍSTICA

EXERCÍCIOS

1. São qualitativas: "sexo" e "período de visita". As demais são quantitativas.

2. a) quatro
   b) 1: Exatas, Humanas e Biológicas
   5: Física, Português, História, etc.
   6: 0, 1, 2, 3

3.

Candidato	Freqüência absoluta	Freqüência relativa	%
Zé Roberto	14	$\frac{14}{30} \cong 0{,}467$	46,7
Zé Maria	7	$\frac{7}{30} \cong 0{,}233$	23,3
Brancos	4	$\frac{4}{30} \cong 0{,}133$	13,3
Nulos	5	$\frac{5}{30} \cong 0{,}167$	16,7
Total	**30**	**1**	**100**

4.

Estado civil	n_i	f_i	%
Solteiro	12	0,4	40
Casado	12	0,4	40
Separado	4	0,133	13,3
Viúvo	2	0,067	6,7
Total	**30**	**1**	**100**

5.

Nº de filhos	n_i	f_i	%
0	12	0,4	40
1	5	0,167	16,7
2	7	0,233	23,3
3	5	0,167	16,7
4	1	0,033	3,3
Total	**30**	**1**	**100**

6. a = 24; b = 6%; c = 0,23; d = 23%; e = 36; f = 0,09; g = 0,45; h = 45%; i = 68; j = 0,17; l = 17%

7.

Nota	Freqüência absoluta	Freqüência relativa	%
1,0 ⊢ 2,5	5	$0{,}1\overline{6}$	$16{,}\overline{6}$
2,5 ⊢ 4,0	5	$0{,}1\overline{6}$	$16{,}\overline{6}$
4,0 ⊢ 5,5	8	$0{,}2\overline{6}$	$26{,}\overline{6}$
5,5 ⊢ 7,0	6	0,20	20
7,0 ⊢ 8,5	3	0,10	10
8,5 ⊢ 10,0	3	0,10	10
Total	30	1	**100**

b) 20%

8. a) x = 18 b) 5% c) 75%

9.

10. a) 360 pessoas b) 270° e 90° c) 78

11. a) Minas: 74,5°; Paraná: 46,5° c) 45 500
    b) 1 792 700

12. a) 1 200 b) 480

13. a) 126°; 126°; 86°; 22° c) aproximadamente 191°
    b) 192

14. a) V b) V c) F d) V

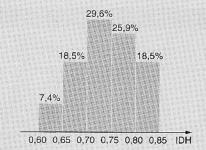
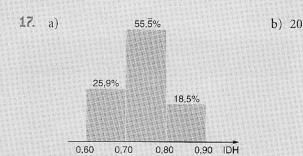
15. a) 861 b) R$ 14 627,50 c) 101

16. a)

IDH	Freqüência absoluta	%
0,60 ⊢ 0,65	2	7,4
0,65 ⊢ 0,70	5	18,5
0,70 ⊢ 0,75	8	29,6
0,75 ⊢ 0,80	7	25,9
0,80 ⊢ 0,85	5	18,5
Total	27	~100

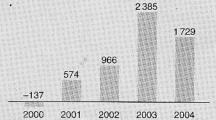
b) 44,4%

17. a)

b) 20

18. a) V b) F c) V d) F

19. a) 20% b) 33,3%

20. a) 2, 7, 8 e 9
b) Crescimento: dias 2 a 4; 5 a 6; 8 a 10.
Decrescimento: dias 1 a 2; 4 a 5; 6 a 8.
c) R$ 12 000,00
d) R$ 32 000,00
e) R$ 1 600,00

21. a) 15 478 b) 593 c) 2,11
d)

22. a) F; o total foi 287 444.
b) F; houve acréscimo de 38%, aproximadamente.
c) V
d) V

23. a) F b) V c) V d) F e) V

24. a) $22,\overline{3}$ b) 8,4 c) $0,1\overline{3}$ d) 5 e) 3

25. 4 **26.** R$ 200,00 **27.** 2,68 kg

28. a) mulheres
b) 56 mulheres e 24 homens

29. a) R$ 60,00 b) R$ 500,00

30. a) 13 b) 10 c) 12,6 d) 36 e) 15

31. a) R$ 610,00 b) R$ 627,50 c) R$ 575,00

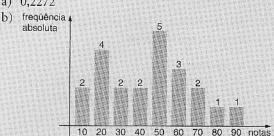
32. 18 **33.** a) 2,15 dias b) 12

34. a) $\overline{M} = 3,\overline{2}$; Me = 3; Mo = 4
b) $\overline{M} = 17,\overline{6}$; Me = 18; Mo = 18
c) $\overline{M} = 3$; Me = 3; não há moda
d) $\overline{M} = 13,5$; Me = 14; Mo = 15
e) $\overline{M} = 43,7$; Me = 43,5; há duas modas: 43 e 44.

35. a) $\overline{M} \cong$ 1 261 712 milhões de dólares
Me = 98 191 milhões de dólares
b) Sem considerar os EUA, a média seria 248 225 milhões de dólares aproximadamente.

36. a) média: 29,125%; moda: 22%; mediana: 28,5%
b) 1992 a 1998; 2000 a 2002 e 2004 a 2006

37. a) $\overline{M} \cong 1,208$; Me = 1,5; Mo = 2 b) 1

38. a) 0,2272
b)

c) 60

39. a) $\sigma^2 = 1$; $\sigma = 1$
b) $\sigma^2 = 2$; $\sigma \cong 1,41$
c) $\sigma^2 = 10,28$; $\sigma \cong 3,21$
d) $\sigma^2 = 0$; $\sigma = 0$
e) $\sigma^2 \cong 307,33$; $\sigma \cong 17,53$

40. a) $13,\overline{3}$ b) 3,65

41. 1,21 gol/partida

42. a) $\bar{x} = 3,25$; d $\cong$ 0,56 b) $\frac{5}{2}, 4, \frac{7}{2}, 3$

43. a) média: 2,86 dólares; 6 cidades
b) 1,78 dólares
c) 33 horas

44. a) O bloco das cidades em que o acesso é mais barato.
b) $\sigma_1 \cong 3,467$ e $\sigma_2 \cong 0,189$; 18 a 19 vezes maior

45. a) F b) F c) F d) F e) F

46. a) $1,\overline{3}$ b) 2 c) 6

47. Pedro: DM = 1
Paulo: DM = 2,4
Na região *A*.

48. a) $\overline{x} = 439$ reais; $\sigma \cong 98{,}2$ reais
b) menor
c) $\sigma \cong 88$ reais

49. a) 220
b) R$ 690,90
c) [500, 700[

50. a) 170
b) 98 kg
c) 97,1 kg
d) 19,4 kg

51. a)

PIB *per capita* (em reais)	Nº de Estados	%
1 500 ⊢ 3 500	6	23,1
3 500 ⊢ 5 500	9	34,6
5 500 ⊢ 7 500	4	15,4
7 500 ⊢ 9 500	4	15,4
9 500 ⊢ 11 500	3	11,5
Total	**26**	**100**

b) R$ 5 653,85
c) classe modal: 3 500 reais ⊢ 5 500 reais
Me = R$ 5 054,91

52. a) R$ 108 911,00 b) R$ 153 571,00

53. a) 50%
b) $\overline{M} = 81{,}375$ minutos; Me = 75 minutos
c) $\overline{M} = 82{,}5$ minutos; Me $\cong 78{,}8$ minutos;
$\sigma \cong 48{,}72$ minutos

TESTES DE VESTIBULARES

1. c
2. e
3. b
4. c
5. b
6. c
7. c
8. e
9. d
10. c
11. d
12. e
13. a) F
b) V
c) V
14. b
15. a
16. b
17. c